APR 19 1948

ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

APRIL 15, 1948

HURRICANE PROTECTION — Concrete pavement 6 in. thick guards against heavy wave action on Miami causeway

BIG-SCALE CONSTRUCTION IN ATOMIC PROGRAM

A special report by R. Colborn, McGraw-Hill Washington Bureau

WEST POINT repipes its rink with BYERS WROUGHT IRON PIPE

Over a period of years, the skating rink at the United States Military Academy had corrosion troubles. Leaks were causing soft spots in the ice, and making frequent replacements necessary. It was recently decided to completely replace the cooling coils, using a corrosion-resistant material. Byers Wrought Iron pipe was installed throughout.

NEW FLOOR SLAB POURED

Removal of the old pipe would have been a difficult and costly job, and so the new wrought iron coils were laid on the surface of the concrete, and a new floor slab poured. The old pipe was cut off from the headers, and the new pipe connected.

CERTIFIED BY SERVICE

The choice of wrought iron for this highly corrosive service follows sound engineering practice. In one of the country's largest rinks, low-first-cost pipe was used in the original installation, and failures appeared in only three years. In the next five years, almost 20% of the pipe was replaced, and it was apparent that a complete overhaul was essential. The entire floor was therefore rebuilt . . . and Byers Wrought Iron pipe was used, which is still serving after 14 years.

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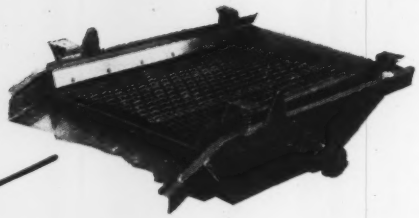

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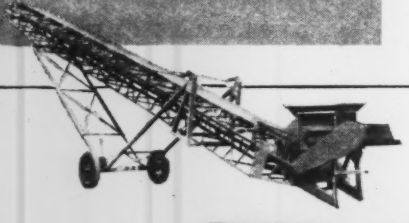

IN NINE MINUTES, one man can easily elevate a 50' conveyor with this new Pioneer Hydraulic Conveyor Truck. A twist of a valve and it's back in its cradle... ready for another move. Handles conveyors up to 50' in length with belts as wide as 30". A reciprocating plate feeder mounted on the conveyor completes the plant.

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Construction Trends

Trends in Construction Materials Shipments

Shipments of three of the most basic construction materials, fabricated structural steel, concrete reinforcing bars and cement, have been shifting position as to relative use during the war and postwar years. In 1947, the index of the shipments of concrete reinforcing bars, on the basis of 1926 as 100, was 159.1, the index of cement shipments, 115.5 and the index of structural steel shipments, 66.5. During the years, 1923 through 1926, the annual average of the index of fabricated structural steel shipments was 95.1, the average of the index of cement shipments, 92.7 and of concrete reinforcing bars, 91.2.

Shipments of fabricated structural steel in 1947 were only 1,915,000 tons, as reported by the American Institute of Steel Construction, compared with 3,600,000 tons shipped for construction in 1929. Structural steel shipments last year were also exceeded in 1941 and in the eight predepression years from 1923 through 1930.

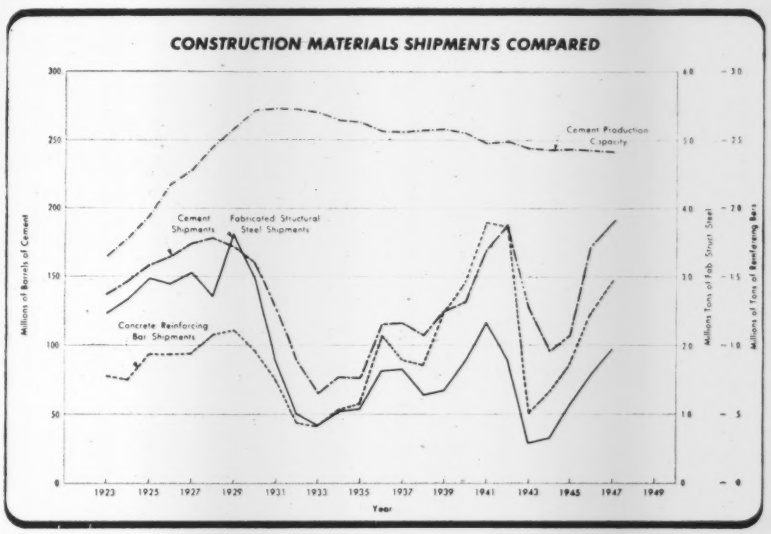
Shipments in 1941 amounted to 2,296,000 tons and during the predepression years, ranged from 2,440,000 tons in 1923 to 3,600,000 tons in 1929. A larger proportion of structural shapes has been going directly to warehouses in recent years at the expense of tonnage reported by fabricators in the industry.

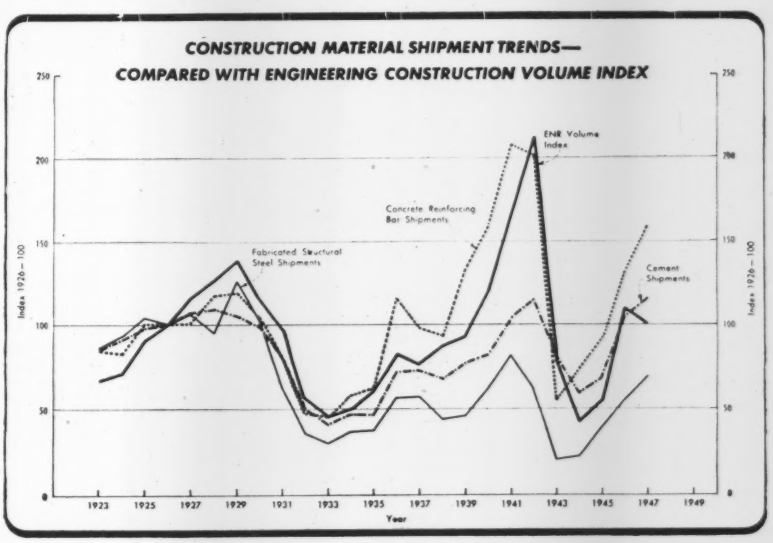
Concrete reinforcing bars shipments, as reported by the American Iron and Steel Institute, amounted to 1,453,000 tons in 1947, an increase of 22 percent over the 1946 volume of 1,190,000 tons, and was the third highest volume shipped in 25 years. The 1947 volume was exceeded only in the war years of 1941 and 1942, when 1,892,000 and 1,845,000 tons, respectively, were shipped.

Cement shipments of 187,400,000 bbls. in 1947 reached an all-time high, as reported by the U. S. Bureau of Mines, exceeding the previous high of 185,300,000 bbls. in 1942 by 1 percent. Compared with the 1946 volume of 169,300,000 bbls., shipments last year showed an increase of 11 percent.

The trend of the physical volume of heavy engineering construction, as measured by the *Engineering News-Record* volume index, most nearly follows the trend of the shipments of concrete reinforcing bars. Although the *Engineering News-Record* volume index dropped to 101 in 1947 from 109 in 1946, a sufficient number of projects were carried over into 1947 to support increased shipments of cement, concrete reinforcing bars and structural steel in 1947. Despite the decline in the volume index from 1946 to 1947, however, the 1947 index was still 87 percent above the 1945 index of 54. The physical volume index is based on 1926 as 100 and adjusted for the rise in construction costs.

Structural steel shipments in 1947 were 72 percent above 1945, reinforcing bars, 74 and cement, 76 percent.





A "LIFEGUARD" FOR EVERY SWIMMER

Modern swimming pool chlorination with economical dependable W&T Chlorinators is like having a "lifeguard" for every swimmer. Whether the bathing load is light or heavy, chlorination is always on the job to destroy bacteria the moment it enters the pool water. It's the safe, sure way to prevent the spread of water-borne infection.

For a "lifeguard" in your design, choose a W&T Chlorinator or Hypochlorinator—precision built for the job and carefully designed from over 30 years' experience—to ensure unfailing chlorination. W&T Equipment is constructed especially for easy operation and upkeep without highly trained personnel, and has the approval of health authorities throughout the country. W&T Reagent Feeders, too, are built to the same high standards to give the most in handling the application of coagulant and other chemicals.

In addition, your W&T Representative, an engineering specialist in chlorination, is always ready to help you with any problem in pool sterilization or equipment selection. Why not get in touch with him today?

Write now for the free booklet, "Swim in Drinking Water", which will give you details on the application of W&T Equipment for pools as well as many helpful hints on pool construction and operation.

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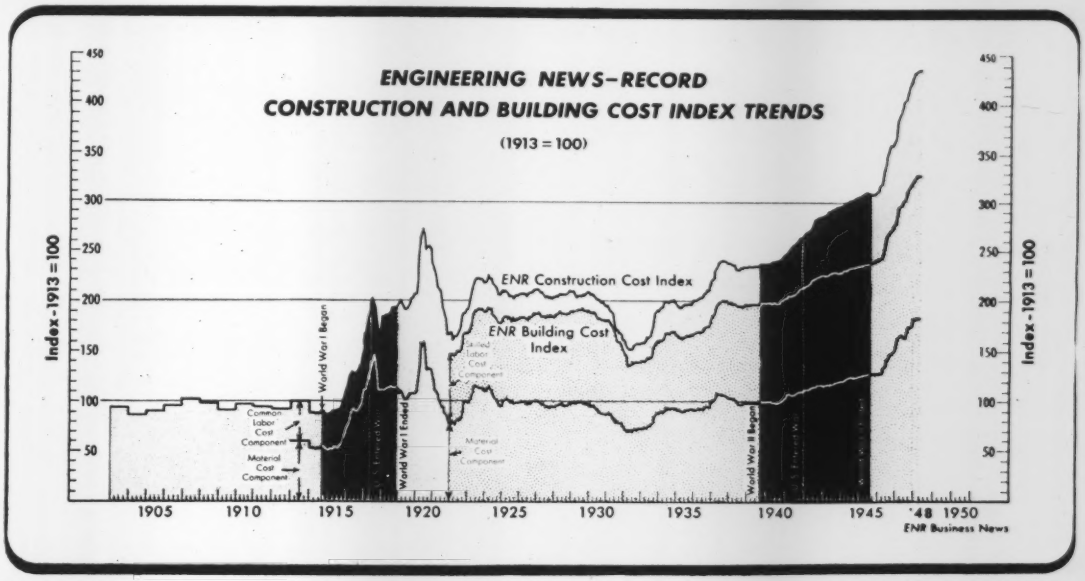
APRIL CONSTRUCTION BUSINESS REPORT



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	March 1947 (4 wk.)	March 1948 (4 wk.)	% Change	Three Months 1947 (13 wk.)	Three Months 1948 (13 wk.)	% Change
Total U. S. Construction	$400,415	$508,096	+27	$1,187,876	$1,424,694	+20
Private Construction	286,049	220,715	−23	794,531	655,254	−18
Public Construction	114,366	287,381	+151	393,345	769,440	+96
Federal	15,547	99,093	+537	87,492	289,508	+231
E N R Construction Volume Index, 1913 = 100	220	250	+14	204	220	+8
Total New Productive Capital	$72,999	$280,726	+285	$256,004	$777,588	+204
Private Investment	72,999	280,726	+285	256,004	777,588	+204
Federal (non-federal work)	.....	.....	.....	.....	.....	.....
Federal (federal work)	.....	.....	.....	.....	.....	.....

CONSTRUCTION COST . . . . WAGE RATES . . . . MATERIAL PRICES

1913 = 100	April 1947	April 1948	% Change	Change March to April 1947 Mar.	1947 Apr.	%	Change March to April 1948 Mar.	1948 Apr.	%
E N R Constr. Cost Index†	396.09	438.50	+10.71	391.95	396.09	+1.06	438.41	438.50	+0.02
E N R Building Cost Index†	300.81	329.42	+9.51	298.84	300.81	+0.66	329.03	329.42	+0.12

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$1.133	$1.287	+13.59	$1.118	$1.133	+1.34	$1.283	$1.287	+0.31
Skilled Labor (Av. 3 Trades)	1.934	2.169	+12.15	1.922	1.934	+0.62	2.153	2.169	+0.74
Bricklayers	2.072	2.343	+13.08	2.056	2.072	+0.78	2.303	2.343	+1.74
Structural Ironworkers	1.937	2.178	+12.44	1.924	1.937	+0.68	2.172	2.178	+0.28
Carpenters	1.793	1.986	+10.76	1.787	1.793	+0.34	1.986	1.986	0.0
Cement, bulk, per barrel	2.50	2.81	+12.40	2.48	2.50	+0.81	2.81	2.81	0.0
Structural Steel, base	2.50	2.80	+12.00	2.50	2.50	0.0	2.80	2.80	0.0
Sand, per ton	1.768	1.943	+9.90	1.761	1.768	+0.40	1.915	1.943	+1.46
Lumber, 2x4 Fir, per M ft.	83.97	98.32	+17.09	82.59	83.97	+1.67	99.32	98.32	−1.01
Lumber, 2x4 Pine, per M ft.	81.91	90.84	+10.90	81.13	81.91	+0.96	91.51	90.84	−0.73
Common brick, per M	22.80	25.375	+11.29	22.80	22.80	0.0	25.325	25.375	+0.20
Ready-mixed concrete, c.y.	8.842	9.982	+12.89	8.789	8.842	+0.60	9.982	9.982	0.0
Struct. clay tile, 3x12x12	107.81	123.47	+14.53	107.293	107.81	+0.48	123.11†	123.47	+0.29

† *Revision.*

MATERIAL SHIPMENTS . . . BUILDING PERMITS

	March 1947	March 1948	% Change	February 1948	% Change Feb. to Mar.
Steel (% operating capacity) A.I.S.I., weekly average	95.9	94.8	−1.1	93.2	+1.7

	January 1947	January 1948	% Change	Twelve Months 1946	Twelve Months 1947	% Change
Cement, thous. bbl. U.S.B. of Mines	8,363	9,205	+10.1	169,336	187,396	+10.7

	February 1947	February 1948	% Change	Two Months 1947	Two Months 1948	% Change
Fabricated Structural Steel, tons, A.I.S.C.	136,126	135,710	−0.3	276,776	280,025	+1.2
Buildings Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	167,100	235,792	+41.1	323,631	522,305	+61.4

COST OF LIVING INDEX . . . . EMPLOYMENT

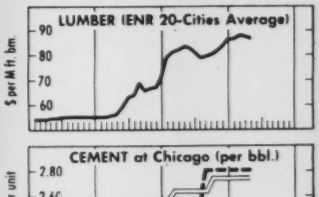
Base 1935-39 = 100	1941	February 1947	February 1948	% Change	January 1948	% Change Jan. to Feb.
Consumers' Price Index, B L S	105.2	153.2	167.5	+9.3	168.8	−0.8
Rent (Housing) Index, B L S	106.2	108.9	116.0	+6.5	115.9	+0.1

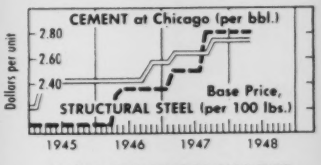
	February 1947	February 1948	% Change	January 1948	% Change Jan to Feb.
Contract Constr. Employ. (est.), thous., B L S	1,502	1,607	+7.0	1,692	−5.0

ENR INDEX NUMBERS

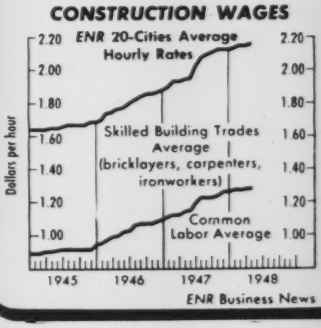
Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Apr., 1948	438.50	210.79	329.42	178.07	...	...
Mar., 1948	438.41	210.74	329.03	177.86	250	110
Feb., 1948	436.89	210.01	329.71	178.23	234	103
Jan., 1948	434.99	209.10	326.92	176.72	175	77
Dec., 1947	432.30	207.81	325.27	175.83	251	110
Nov., 1947	429.30	206.36	322.27	174.21	238	104
Oct., 1947	424.41	204.01	320.58	173.30	234	103
Sept., 1947	417.81	200.84	317.08	171.40	255	112
Aug., 1947	415.00	199.49	313.03	169.21	215	94
July, 1947	406.52	195.41	304.87	164.80	222	97
June, 1947	403.29	193.86	303.14	163.87	276	121
May, 1947	396.49	190.59	299.61	161.96	224	98
Apr., 1947	396.09	190.40	300.81	162.61	247	108
Mar., 1947	391.95	188.41	298.84	161.54	220	96
1947 (Av.)	407.13	195.71	307.68	166.32	231	101
1946 (Av.)	345.94	166.29	262.25	141.76	248	109
1945 (Av.)	307.75	147.93	239.14	129.27	123	54
1944 (Av.)	298.72	143.59	234.73	126.89	96	42

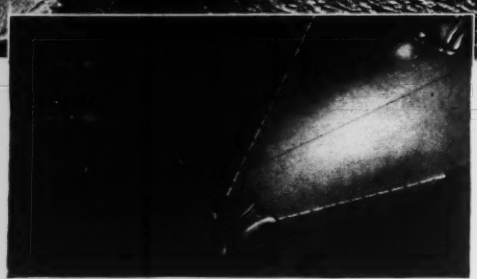
MATERIAL COST PRICES



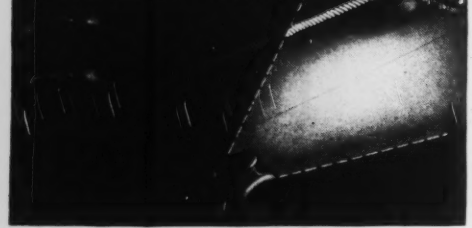


CONSTRUCTION WAGES





A smooth curb wastes the car's headlights. It reflects light away from the driver. Edge of road is difficult to see. Driving dangers are increased.



White Concrete Reflecting Curb utilizes the car's headlights. Saw-tooth faces mirror the light back to driver; form a continuous, bright ribbon of light at the road's edge. Driving is safer.

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By day or by night, the visibility of Atlas White Reflecting Curb is high. In the daytime, its whiteness distinguishes it from darker pavement. At night, its saw-tooth faces catch the headlight rays and reflect them back to the driver . . . clearly defining the road ahead and making driving safer. And on rainy nights, this curb is even more mirror-like . . . gives even higher visibility just when needed most.

Send for full details. Write to Atlas White Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, New York.

ENR-RM-50

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ATLAS WHITE CEMENT

For White Concrete Reflecting Curb

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel—Sunday Evenings—ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • APRIL 15, 1948 • VOLUME 140 • NUMBER 16

Army engineers announce VA hospital bid schedule

Monthly program to cover 40 more projects in 1948— Veterans Administration reviews its share of program

The Corps of Engineers last week announced a tentative schedule, by months, that calls for advertising 40 additional Veterans Administration hospital projects before the end of 1948.

According to this schedule, three hospitals will be advertised for bids during the second quarter of 1948, 14 will be offered during the third quarter, and 23 are listed for the last quarter. In addition, VA itself expects to open bids for one in the second quarter.

During the first quarter of 1948, contract awards in that part of the VA hospital program being carried forward by the corps doubled the total awards for the full year of 1947, Lt. Gen. Raymond A. Wheeler, chief of engineers, said. Between Jan. 1 and March 31, the engineers awarded contracts totaling nearly $88,700,000 for 12 general medical hospitals. Bids for two more were opened early in April.

Meanwhile, VA in the first quarter awarded contracts for two new hospitals and one addition.

Including awards made in 1946 and 1947, the engineers at the end of March had under contract 23 hospitals to cost a total of $194,253,000. These hospitals will provide 10,386 beds at an average construction cost of $18,700 per bed.

Increased construction costs delayed the hospital program in 1946 and 1947 by making necessary the redesign of practically all hospitals that had not already been placed under contract.

VA progress

Of a total of 89 new hospitals in the VA's current construction program, 25 are under contract, bids for two have been opened, 41 will be advertised this year, and 20 are in earlier stages of planning. The program also includes four hospital additions under contract and seven in the planning stage.

This overall list of new hospitals and additions will provide 54,031 beds. The total of appropriations and contract authorizations available for construction is $1,017,000,000.

Of the 89 new hospitals in the current program, the army engineers are responsible for construction of 71.

Included in the list of 40 hospitals to be advertised before the end of the year are 26 general medical and surgical institutions, four for tuberculosis, eight for pneurosychiatric cases, and two to have separate buildings for general medical and tuberculosis patients. The single project for which VA will take bids is a general medical hospital of 200 beds at Marlin, Texas. May 25 is the tentative date for opening bids.

Bid dates listed

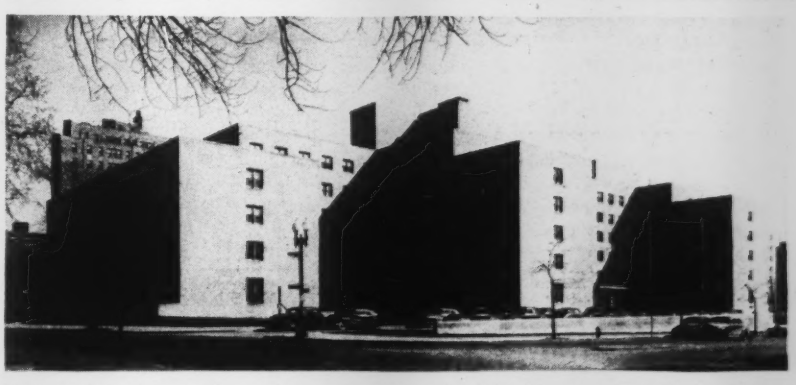
Hospitals which the Corps of Engineers plans to advertise are listed in the following paragraphs, by months. The district engineer will advertise for bids for each hospital, and will award the contract. The forecasts of the months in which advertisements will be released are subject to completion of plans on the basis of projected rates of progress. Some change in the months may prove necessary later.

May—Manchester, N. H., 151 beds; June—Norman, Okla., 750 beds; Seattle, Wash., 300 beds; July—Greenville, S. C., 200 beds; Detroit, Mich., 500 beds; Miles City, Mont., 100 beds; Bonham, Tex., 350 beds; August—Harrisburg, Pa., 200 beds; Tupelo, Miss., 200 beds; Louisville, Ky., 750 beds; El Paso, Tex., 500 beds; Houston, Tex., 1,000 beds.

September—West Haven, Conn., 900 beds; Tallahassee, Fla., 100 beds; Grand Rapids, Mich., 200 beds; Pittsburgh, Pa., 1,200 beds; Mound Bayou, Miss., 200 beds; October—Philadelphia, Pa., 1,000 beds; Baltimore, Md., 300 beds; Birmingham, Ala., 500 beds; Gainesville, Fla., 1,000 beds; Americus, Ga., 250 beds; Decatur, Ill., 250 beds; Toledo, Ohio, 1,000 beds; Duluth, Minn., 200 beds; Cincinnati, Ohio, 750 beds; Dallas, Tex., 500 beds.

November—Charlotte, N. C., 500 beds; Durham, N. C., 500 beds; Iowa City, Iowa, 500 beds; Madison, Wis., 500 beds; St. Louis, Mo., 100 beds; New Orleans, La., 500 beds; Salt Lake City, 500 beds; Phoenix, 200 beds.

December—Chattanooga, Tenn., 500 beds; Pittsburgh, Pa., 1,250 beds; Jefferson Barracks, Mo., 500 beds (addition); Kansas City, Mo., 500 beds; January—Salisbury, N. C., 960 beds.



***University Hospital** — Now operating in Washington, D. C. is George Washington University's new 400-bed, $4,000,000 teaching hospital. Financed by the U. S. Government, the 400 x 185 ft. H-shaped reinforced concrete structure is primarily for research, and has nine air conditioned operating rooms. Charles H. Tompkins Co., Washington, was the builder.*

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Public construction—The Metropolitan Airports Commission has sold a $5,200,000 bond issue for airport development at *St. Paul-Minneapolis, Minn.* . . . Carson Const. Co., Helena, Mont., has been awarded a $1,776,900 contract to build an Indian Service sanatorium at *Sitka, Alaska* . . . Plans are being prepared for a $10,000,000 building program at Washington State College, *Pullman* . . . Southern Methodist University, *Dallas, Tex.*, will start work soon on its $2,000,000 Fondren Hall of Science . . . Construction is expected to start soon on a new concrete dam at the Seattle City Light's Gorge powerhouse on the Skagit River . . . An $8,000,000 shopping center is to be built on the Newburyport Turnpike at *Peabody, Mass.* . . . A $4,000,000 expansion program involving nine new buildings is being considered for the University of North Dakota at *Grand Forks.*

Industrial construction—Aluminum Company of America is using more than 6,250,000 lb. of aluminum in its nearly-completed sheet and plate rolling mill at *Davenport, Iowa* . . . A $12,000,000 pulp mill, projected by H. R. MacMillan interests in British Columbia, may be built on the southern side of the harbor at *Nanaimo, B. C.* . . . Lehigh Portland Cement Co. has plans to double capacity at its *Metaline Falls, Wash.*, plant at a cost of at least $1,000,000. . . . A new $1,500,000 hotel near Wilshire Country Club, *Los Angeles, Calif.*, will be completed this summer . . . The Duke Power Co. plans construction of two steam-electric generating plants on the Saluda and Broad rivers in *South Carolina* at a cost of approximately $20,000,000 . . . A 10-story department store will be built in *Vancouver, B. C.*, on the site of the old Hotel Vancouver. . . . Southwestern Bell Telephone Co. will build a $1,000,000 dial plant at *Joplin, Mo.* . . . Work is to start soon on a $1,000,000 National Guard armory in *Arcadia*, a suburb of *Los Angeles.*

Highways — Street improvements needed in *Lincoln, Neb.*, may cost $1,400,000 according to city engineer D. L. Erickson . . . The Province of *Prince Edward Island, Canada*, has voted $1,085,000 for roads and bridges . . . A record state road-fund income of $38,330,000 for the new fiscal year is forecast by Revenue Commissioner H. C. Reever of *Kentucky* . . . *Ontario* has voted $57,000,000 for highway construction in 1948.

Housing — The government of the Province of *Ontario, Canada*, has committed itself to spend up to $30,000,000 to encourage construction and purchase of new moderately-priced homes and to help cities in slum clearance . . .McClosky Homes, Inc., will build a 275-home, $2,227,500 community in *Philadelphia, Pa.* . . . The Delaware Court of Chancery has upheld the construction of a proposed $5,000,000 garden-type rental project at Kennett Pike and Barley Mill Road, Westover Hills, *Wilmington, Del.* . . . Provident Mutual Life Ins. Co. has plans for Pennsylvania's first large housing project by an insurance company. The site is on 105 acres in the East Oak Lake section of *Philadelphia*, and would house 1,000 families at a cost of $12,000,000.

Sewers and water—J. A. Terteling & Sons, Inc., has a contract for a lift station and comminutor station, a treatment plant and 30-in. mains at *Richland* and *North Richland, Wash.*, and for a 2 mg. reservoir, wells, pumping, chlorinator station and supply mains . . . A contract has been awarded to G. A. Bass, Engr. & Const. Co. for a second water purification plant at *Richmond, Va.*, to cost $1,393,800 . . . Bids have been received for a $500,000 project to extend sewer and water lines at *Minot, N. D.* . . . A bond election will be held this month for a $900,000 disposal plant at *Hot Springs, S. D.* . . . The Metropolitan Sewer Board should spend $15,695,000 on sewers for *Louisville, Ky.*, and surrounding areas within the next 10 years, Metcalf & Eddy, consultants, reported.

Chemical Office—To house 900 employees at its South Charleston, W. Va. offices, the Carbide & Carbon Chemicals Corp. is now completing this 11-story steel frame and brick building. Designed by W. Y. Cocken, Pittsburgh architect, the structure is completely air-conditioned. George A. Fuller Co., New York City, is contractor.

Heating cost rise marked in New York

Cost of supplying and installing heating and ventilating equipment has risen more than 50 percent in less than a year in the metropolitan area of New York, it became apparent last week.

The cost jump—made more obvious by comparison to the more stable prices on other building components—was notable when the New York City Housing Authority received bids recently on installations for its new Astoria Houses development in Queens County. Low bid for supplying and installing the equipment to supply the proposed 23 six-story buildings in the apartment development, set a price of about ten cents per cubic foot, as compared to similar projects of the authority where the cost averaged eight cents per cubic foot less than four months ago.

A spot check of contractors and suppliers placed the blame for the jump on on shortage of steel pipe, and the resultant use of more expensive substitutes, greater allowance for contingencies, and payment of "black market" prices for immediate deliveries.

Mayor charges collusion in Minneapolis paving

The Hennepin County, Minn., grand jury will be asked to investigate Minneapolis paving materials contracts for 1948 jobs, Mayor Hubert H. Humphrey said last week.

The mayor declared that a discussion he has had with George R. Arneson, city purchasing agent, has led him to believe that charges of collusion and price-fixing made by the Minneapolis "Tribune" on Feb. 27 are "substantially correct." The newspaper pointed out alleged inter-connecting managements of bidders on city sand and gravel contracts.

The mayor cited three bidders as being closely linked: Minnesota Sand and Gravel Co., Aggregate Sales Association, and Industrial Aggregate Co. He said he will ask the city attorney to determine whether the alleged "price-fixing and collusion" of bidders is legal, as some have claimed it to be. Meanwhile, he is withholding his signature from the paving materials contracts.

Humphrey does not deny that Minneapolis is able to obtain its paving materials at prices substantially lower than those in St. Paul, but this, he claimed, is because St. Paul city contracts all are let to a single company, which is at liberty to fix its own prices.

Building unions gain new wage boosts

Settlements of construction labor disputes on a pattern of wage increases ranging from 12½ to 20 cents per hour were the salient feature in the construction labor field last week.

Builders at Cleveland, Ohio, hailed completion of all wage negotiations with building trades unions, which included the signing of eleven separate contracts. Jack E. Burns, secretary of the Building Trades Council, said that the occasion was the first in more than three years when all contracts were signed before the expiration of previous agreements.

The last of the series of agreements was signed by carpenter and bricklayer groups, which accepted hourly wage increases of 20 and 12½ cents, respectively. Highest wage increases won by union groups in Cleveland were for asbestos workers, cement finishers, glaziers, sheet metal workers, plumbers, steam fitters and tile setters, all of whom received 25 cents an hour increases.

At Milwaukee, Wis., labor union representatives said that their men were willing to accept a wage increase pattern of 20 cents an hour to cover almost all trades, after it was offered by contractors groups. At Eugene, Ore., a two months old wage dispute between contractors and carpenters was settled with union acceptance of a pay scale providing $1.95 an hour for journeymen carpenters, and a 20-cent-an-hour increase for all classifications of labor under the carpenters' jurisdiction.

Other settlements

Other settlements reported during the week included:

A new contract providing AFL common laborers in Columbus, Ohio, with increases of 12½ cents an hour, with increases of 15 cents an hour for hodcarriers, mason tenders and jack handlers; and an across-the-board 17½c. hourly wage increase awarded to four Portland, Ore., building trade unions by an arbitration board.

Disputes and strikes, however, continued.

At Providence, R. I., members of the cement finishers union (AFL) went on strike to enforce their demands for a 40-cent hourly wage increase; labor representatives called on the State Industrial Commission at Madison, Wis., for an increase in minimum wage rates for highway construction workers; general contractors and subcontractors in Jefferson County (Birmingham), Ala., were notified by the building trade unions that after April 1 no member of affiliated crafts in the building and construction industry will be permitted to work on any job when one or more of the respective crafts are not 100 percent union.

Strikes have halted major construction projects in two West Virginia cities in disputes between unions and contractors over wage contracts that expired on March 31. An estimated 3,000 construction workers were idle in Charleston and in the Kanawha Valley as a result of a dispute between 19 building unions and the Charleston Construction Association. At Parkersburg, about 600 members of the Hod Carriers and Laborers Local brought construction work in that area to a virtual halt when their demands for a 25 to 50c. raise were not met.

Court declares housing not interstate work

A secondary boycott injunction sought under the Taft-Hartley law by the National Labor Relations Board against AFL building trades unions in Denver, Col., has been denied for these reasons: the housing construction involved was intrastate in character and the dispute did not affect commerce.

Because of the facts in this case, it was not felt at NLRB that a general precedent was established.

The Denver situation involved the AFL Building Trades Council and locals of carpenters, electricians and plumbers. They had placed Gould & Preisner, electrical contractors, on the "unfair" list and picketed a housing project under construction by Doose & Lintner, general contractors. Gould & Preisner had subcontracted the installation of electric wiring and fixtures.

Complete building disputes machinery

With the appointment last week of John T. Dunlop as impartial chairman, the National Joint Board for Settlement of Jurisdictional Disputes in the construction industry is almost ready to function.

Mr. Dunlop, an associate professor of the Harvard University graduate school and a former adviser to the government on economic affairs, will be ready to begin work on May 1. His appointment completes the board, which was ratified recently by AFL building trades unions, the Associated General Contractors and a group of specialty contractors (*ENR* Feb. 19, vol. p. 235). Established specifically for the benefit of the ratifying groups, the machinery of the board will also be available to all members of the construction industry for avoiding strikes over jurisdictional issues.

Offices of the new board will be set up in the American Federation of Labor Building in Washington, D. C.

Announcement of Prof. Dunlop's appointment and the effectuation of the program on May 1 was made by James D. Marshall, assistant managing director of the AGC, and Richard J. Gray, president of the AFL building trades group. They said that requests for decisions in jurisdictional disputes may be made to the board by any of the 19 international unions affiliated with the building trades; by contractors groups which signed the agreement, and by others if they hire AFL workers and are willing to be bound by the decision. Some 30 new jurisdictional issues that have never reached decisions of record are pending.

Most of the work will be done by the nine-member Board of Trustees, of which Prof. Dunlop will be chairman. The trustees will screen requests by dropping those issues which have already been decided; and will pass on new cases to the Joint Board—which will consist of Dunlop and two representatives each for management and labor. Although Prof. Dunlop will serve as chairman of every board, other members will be selected for individual cases from pools of 12 men, maintained by either side.

With costs shared equally by management and labor, the plan is effective until Dec. 31, but spokesmen for both sides expect it will continue.

Decisions of the Joint Board will be binding on all unions affiliated with the building trades department, and on all contractors party to the agreement. There are to be no strikes or lockouts over jurisdictional questions, while the board is considering the individual cases. At least one union—the electrical workers—is opposed to the program, but will have to abide by decisions unless it wishes to withdraw from the building trades department.

Industry trustees are: Mr. Marshall, E. P. Palmer, Senior & Palmer, New York; Paul M. Geary, representing the National Electrical Contractors Association, and H. R. Cole, executive secretary of the Tile Contractors Association. AFL men are: Mr. Gray, M. A. Hutcheson of the carpenters union, and William O'Neill, of the plumbers union, and James W. Close, of the sheet metal workers.

New maps being made for West Virginia

West Virginia is embarking on a 5-year program of reinventorying and remapping all 33,000 mi. of roads in that state, with the first maps scheduled for completion by the State Road Commission some time this summer.

When completed, the new set of maps —one for each of the 55 counties in the state—will replace the state's existing county maps which were traced in 1937 from U. S. Geographical Surveys.

The new maps are being prepared from aerial mosaics made especially for the state by the U. S. Department of Agriculture. Mosaics first are interpreted at a scale of 2 in. equal 1 mi., onto transparent plastic sheets, showing all roads, streams and railroads.

A base tracing is made on linen from each plastic tracing. Field parties, travelling by cars equipped with accurate speedometers and by walking roads impassable by car, make a complete inventory of all items of "culture", such as houses, farms, churches, etc.

This culture is transferred to the base tracings, denoted by various symbols. Route numbers and types of surface, both improved and unimproved, also are shown for all roads. All printing on the maps is by the "stick-up" process, using various types for the different features. Final step is to lithograph each map, in black and white to a scale of 1 in. equals 1 mi.

Indiana reports severe winter road damage

An unusually hard winter, an increase in overweight trucks and insufficient funds allocated for maintenance have practically destroyed an estimated 324 miles of the 10,000 miles of main highways in Indiana, according to Prof. K. B. Wood of Purdue University, as reported by him recently to the National Highway Research Board.

Violation by overloaded trucks have increased 100 per cent in the 3-year period ended in 1946, he reported. The ratio in this type of highway damage continued to increase in 1947, he said.

Highway department engineers have suggested the building of deeper and stronger highway foundations and thicker paving as a remedy for winter damage and use by heavy trucks.

Big 1948 road program announced for Oklahoma

Oklahoma's 1948 road building program, calling for the expenditure of $44,925,000 on road construction, repair and maintenance, was released March 17 by the state commission.

It was the first full program released by the new eight-member road commission, and includes some projects on which work already has been started or completed, and some projects which still await final approval of the PRA.

Inspection staff lack blocks Ky. road work

A shortage of inspection personnel in the Kentucky Highway department will prevent it from spending the new gasoline-tax money on rural roads this year, according to D. H. Bray, chief engineer.

The gasoline tax has been increased lately from 5 to 7 cents a gallon and the 1948 legislature had appropriated this money for rural roads.

British Columbia roads to cost $18 million

An $18,600,000 highway program will be undertaken by British Columbia during the year 1948-49.

The program, outlined to the provincial legislature by Works Minister E. C. Carson includes:

Reconstruction and construction of 124 mi. of main highway at about $5,000,000. Paving of 465 mi. of road at a cost of $3,100,000.

Construction of 38 major bridges, replacement of 80 small bridges with culverts and fills and allocation of $300,000 for bridges in the Fraser Canyon in a replacement program totaling $2,500,000.

Expenditure of $7,000,000 on maintenance, $1,000,000 more than last year and the largest in B. C.'s history.

Purchase of heavy construction and maintenance machinery totaling $1,000,000.

Carson said that despite the $1,000,000 boost for maintenance, the department would not be able to do as much work as before, due to increased costs.

York-Harrisburg road planning contract let

The Pennsylvania Department of Highways has awarded a contract to Michael Baker, Jr., Inc., Rochester, Pa., for engineering surveys and plans of the proposed York-Harrisburg Highway. The new road will be a link in the planned multi-million dollar Baltimore-Harrisburg Express Highway.

The contract covers approximately 22 miles of new highway to be designed as a 4-lane divided road.

The section covered in the Baker contract extends from near George and Hamilton Streets in West Manchester Township, near York, to the proposed Harrisburg Expressway being designed with a view of constructing a new bridge across the Susquehanna River in South Harrisburg.

Boston engineers observe centennial

The Boston Society of Civil Engineers last week celebrated the 100th anniversary of its founding. The group is now the oldest engineering society in the United States.

Frederic N. Weaver, professor and chairman of the civil engineering department at Tufts College, Medford, Mass., was elected president.

Speakers at the centennial meeting stressed the important contributions to engineering progress made by members of the society over the past 100 years. Cited among their achievements in the transportation field were the first railway, first electrified railroad, first large tunneling project using compressed air drills, and the first subway for trolley cars.

New England engineers also were hailed as first to develop sanitary science as a separate division of civil engineering, under the leadership of such Boston Society members as Whipple, Mills and Hazen. Other members, notably Herschel and Francis, were pioneers in hydraulic developments.

In addition to Professor Weaver, new officers elected were: vice president, Harrison P. Eddy Jr., Metcalf & Eddy; secretary, Robert W. Moir, Metropolitan District Commission; treasurer, Herman G. Dresser, Camp, Dresser & McKee; directors, Chester J. Ginder and Frederick S. Gibbs.

FREDERIC N. WEAVER
. . . heads Boston engineers

ASCE spring meeting focuses attention on Pittsburgh expansion problems

Traffic, stream pollution and sewage treatment planning for Steel City are described—Society moves to increase membership.

Plans for increasing its membership and reopening the question of increased dues were set in motion by the American Society of Civil Engineers at its meeting last week in Pittsburgh, Pa., where the technical sessions, extending over two days, concentrated on the convention city's always pressing engineering problems. Ten of the twenty-six papers on the program had a local slant.

A special committee composed of the society's four vice-presidents, working with the directors and local section presidents, will concentrate on bringing the many advantages of society membership to the attention of engineers who are not now members. The question of increased dues was reopened through the receipt of two petitions from each of the four zones of the society, signed by many more than the required 75 corporate members of each zone. One petition contemplates a raise in dues covering all members, while the other would eliminate the present residential dues differential in District 1, the Metropolitan New York area. Both petitions will be up for discussion at the summer convention in Seattle. Constitutional changes covered by the petitions are scheduled to be submitted to a vote of the membership by letter-ballot following the Seattle convention, July 21-23, with the ballots to be counted in October.

Chandler made assistant secretary

By action of the Board of Direction, E. L. Chandler, eastern representative of the society at Washington, D. C. for the past four years, was appointed assistant secretary, effective April 1, succeeding J. E. Jagger who resigned in March.

The board also approved President Dougherty's appointment of the following delegates on 1948 international conferences—all to serve without expense to the society:

Second International Conference on Soil Mechanics and Foundation Engineering, Rotterdam, Holland, June 1948: F. A. Marston (chairman), C. S. Proctor, J. D. Justin, T. A. Middlebrooks, P. C. Rutledge, T. E. Stanton and C. B. Spencer.

Conference on Large Dams, Stockholm, Sweden, June 1948: G. A. Hathaway (chairman), J. D. Justin, L. F. Harza, C. P. Vetter, and E. M. Dycker, the latter of Drammen, Norway.

International Association of Hydraulic Structures Research, Stockholm, June 1948: J. B. Tiffany (chairman), L. G. Straub, B. A. Bakhmeteff and A. E. Cummings.

International Conference on Large Electric Systems, Paris, France, June 24—July 3, 1948: Philip Sporn of New York City.

Other actions of the board included: (1) approval of the new constitution of the Engineers Joint Council, (2) reaffirmation of its previous stand that ASCE at present cannot increase its contribution to the Engineering Societies Library (3) approval of the Canons of Ethics adopted by the Engineers Council for Professional Development last fall; and (4) accepted sponsorship of a new Council on Research in Reinforced Concrete, to be financed by Engineering Foundation and private grants.

E. L. CHANDLER

. . . assistant ASCE secretary

The following locations for 1949 meetings of the society were approved: January, New York City; April, Oklahoma City; July, Mexico City; and October, Washington, D. C.

At the general luncheon meeting, emergence of civil engineers from the confines of purely technical thinking and assumption of leadership in national affairs and in world efforts for peace were urged by Ben Moreell, honorary member of ASCE, president, Jones & Laughlin Steel Corp. and former chief of the Navy's Bureau of Yards and Docks. Admiral Moreell emphasized that the frontiers of engineers are always before them. The disappearance of geographical frontiers, said he, does not put the engineer out of business, nor does it reduce his field of activity.

Pittsburgh's problems presented

Pittsburgh is seething with a great variety of planning for engineering development, with some construction now underway. Hence, it was appropriate that a large portion of the technical sessions be devoted to engineering works in that area. A three-paper symposium presented at the Highway Division covered in detail the $40,000,000 Penn-Lincoln Parkway, part of which is now under construction. An over-all description of this 60-m.p.h., four- and six-lane expressway (*ENR*, Oct. 30, 1947, vol. p. 608) was given by E. L. Schmidt, chief engineer, Pennsylvania Department of Highways. George S. Richardson, consulting engineer, Pittsburgh, outlined traffic requirements of the proposed two-mile interchange section of the parkway at its western terminus in downtown Pittsburgh. Termed the most important element of the parkway, this so-called "interchange" will be 10,500 ft. long with connections to various streets through-

(*Continued on page* 62)

See $2.8 billion Canadian construction

Capital expenditure in Canada, covering new buildings, new machinery and repairs, is expected to reach an all time high of $2,800,000,000, during the year 1948, according to two reports presented to the Canadian Parliament by Trade Minister C. D. Howe.

The reports, prepared by the Reconstruction Department which Mr. Howe also heads, are based on detailed surveys of 13,000 business establishments and on estimates of capital spending by federal, provincial and municipal governments. One report deals with proposed expenditures, the other with anticipated availability of building and other materials.

The actual increase is not expected to exceed the 1947 physical volume of construction by more than five per cent, though the estimated capital cost will be more because of continually rising prices. Compared with about a billion dollars worth of construction in 1947, the estimate for 1948 amounts to $1,600,000,000. The greatest spending is to be expected in Ontario.

ASCE spring meeting

(*Continued from page 61*)

out its length. An estimated 170,000 vehicles per day will pass through and in the immediate vicinity of the interchange, of which the parkway itself will carry 56,000 vehicles.

Squirrel Hill tunnel, a part of the parkway and to be located about 4½-mi. from downtown Pittsburgh was described in detail by Ole Singstad, consulting engineer, New York City. Contracts are expected to be let soon for construction of this tunnel which will be 4,275 ft. long with twin tubes. Each tube will carry a 24-ft. roadway and one 2-ft. 7½-in. sidewalk.

Other papers relating to Pittsburgh were concerned with regional planning (in the Surveying and Mapping Division session) and with stream pollution and sewerage planning (in the Sanitary and Hydraulic Division session). Speaking on Pennsylvania's stream pollution abatement program as it affects the Pittsburgh region, Elmer A. Holbrook, engineering dean of the University of Pittsburgh, attributed much of its success to the backing of the state's attorney general and governor in pushing enforcement of the law. The problem in the Pittsburgh area has been difficult because streams are large, and industries and cities felt that they could safely dump wastes. Now, to establish a level of fairness between large and small streams, both are to be treated alike by setting standards for different wastes, and requiring all to adhere to them. Dean Holbrook estimated it will cost $1 billion dollars to clean up Pennsylvania streams.

Discussing the sewage problem, John F. Laboon, chairman, Allegheny County Sanitary Authority, pointed out that Pittsburgh is the last major city in the country to undertake sewage treatment. To be financed through revenue bonds, its program is planned for a population of 2 million in the year 2,000. It will require 250 miles of interceptors, 52 miles of which it is proposed to lay in the river beds to save the cost of land excavation. The treatment plant will be located downstream on the Ohio River. It will handle all industrial wastes possible (up to 40 mgd), but will not be able to take all of the acid mine wastes, which must be reduced at the source from their present high volume of 3,600 tons per day.

Bluestone Dam construction

One of the highlights of the meeting from both an entertainment and educational viewpoint was a full-length color movie of the construction of Bluestone Dam, in West Virginia. Description of the dam construction, accompanying the movie, was given at a Construction Division session by Orval Auhl, general superintendent, Dravo Corp., Pittsburgh, Pa., contractors on the work. Of particular note was the fact that no fatality occurred on the dam work until after 2,268,100 man-hours had been chalked up. Twenty years ago, said Mr. Auhl, on projects of this magnitude, one workman was lost on an average of every 200,000 man-hours of work. By this yardstick, twelve men instead of only one would have lost their lives at Bluestone Dam by April 1 of this year, he concluded.

A paper prepared by D. W. Winkleman, president of the Associated General Contractors of America, giving the contractors' version of methods of reducing highway construction costs, was received with marked attention at the Construction Division session.

Lower costs, said Mr. Winkleman, can be achieved through clear, concise specifications that give bidders specific foreknowldge of what is to be required, rather than leaving many items to the discretion of the engineer. Moreover, the specifications should be definite enough to set forth clearly the details and character of the construction, yet should be flexible in interpretation and application in order not to work a hardship on the contractor.

Results should be specified, contends Mr. Winkleman, not methods. Operations that might well be dispensed with entirely, since they contribute little to the efficiency of the project, include hand rubbing of concrete, fine grading, slope rounding, hand finished of graded earth roadways, and tolerances too limited to permit the use of economical machine work. Some states have eased these tolerances where such action will not impair the structure or highway, he said. The outcome of larger tolerances would be great mechanizations, with attendant lower costs, concluded Mr. Winkleman.

Airport terminal facilities

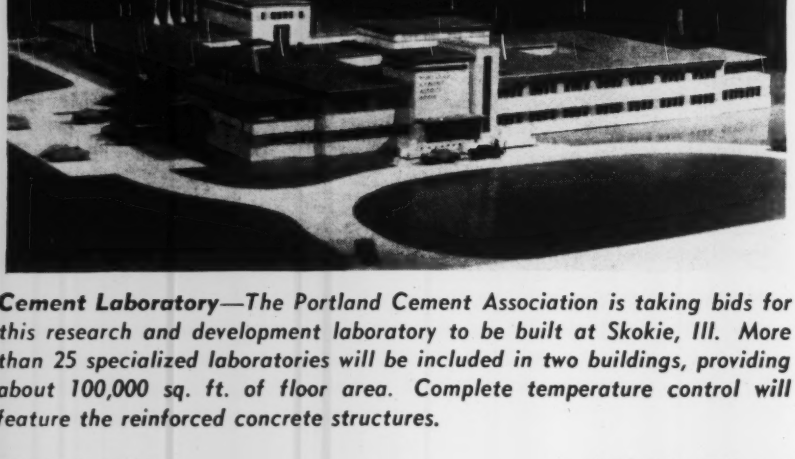
More than 90 percent of all civil airports have been conceived and developed without a clear picture of basic engineering and economic requirements. This was brought out in a symposium conducted by the Air Transport Division, with speakers being: J. B. Bayard, Jr., St. Louis; G. Meredith Muscik, Denver; and H. P. Beach, Jr., Washington, D. C.

Lack of appreciation on the part of public officials of the impact of airports on community life, and collective apathy on the part of architects and engineers in performing the planning function where it is most needed in the first preliminary phase, were blamed by the speakers for the hodge-podge development of airports to date.

Airports should be so planned, the speakers asserted, that their terminal facilities, although representing only a minor part of the total cost of an airport, can be properly conceived, developed and managed to produce the majority of the airport's revenue. The public gains its impression of the airport from the terminal facilities and continuing public support is essential for continuing airport developments.

Trends in lock design

Lock sizes, design of emergency bulkheads, and contemporary construction methods were covered in four papers



***Cement Laboratory**—The Portland Cement Association is taking bids for this research and development laboratory to be built at Skokie, Ill. More than 25 specialized laboratories will be included in two buildings, providing about 100,000 sq. ft. of floor area. Complete temperature control will feature the reinforced concrete structures.*

at the Waterways Division meeting. Determining the proper size of navigational locks in the development of waterways is of utmost importance, declared Ralph L. Bloor, chief, engineering division, Corps of Engineers, Washington, D. C.

Lock sizes adopted in the past, said he, often have been too small to utilize the full life of the structure and prevent stifling the development of traffic for which the improvement was designed. Factors in determining correct lock sizes include: (1) economic studies based on probable future increases in traffic, (2) future increases in size of tows, (3) minimum delays to traffic and (4) high cost of providing additional locks as traffic increases.

Advocating more extensive model studies for design of locks, A. F. Griffin, chief engineer, Upper Mississippi Valley Division, Corps of Engineers, St. Louis, Mo., pointed out that many hydraulic lock systems in this country, while effectively transporting the traffic, are seldom operated in conformity with principles included in their design. In many cases, operating time has been increased over that planned in the design, resulting in lowered efficiency.

Much remains to be accomplished in improving the efficiency of lock filling and emptying systems, declared Mr. Griffin. Furthermore, it is both possible and practical, through the use of model studies, to design systems to provide fast and safe operation without creating intolerable conditions either in the approach channel or within the lock chamber, he concluded.

The ever recurrent question of control of flow through the lock chamber in the event of direct intercommunication of water levels is still a problem of considerable magnitude to the designers. This is the opinion of C. E. Blee, chief engineer, TVA, Knoxville, Tenn., who presented a paper on emergency lock gates and bulkheads. The current trend in lock design, said he, is toward more reliance on precautionary and protective measures, rather than controlling the damage after it occurs.

Methods vs Specifications

Although the construction industry has kept abreast of the times and is in a position to do its share in the continued canalization of our waterways, continued improvement of construction methods is necessary to keep pace with changing specification requirements. This is the contention of Carlton B. Jansen, president, Dravo Corp., Pittsburgh, who traced the development of construction methods on canal and dam construction through the past several years. Safety continues to be an important item, said he, although experience in accident prevention has improved to a satisfactory degree.

Welding, light gage steel and aluminum were discussed in three papers presented to the Structural Division meeting by Leon C. Bibber (Carnegie-Illinois Steel Corp); Tappan Collins (Stran-Steel Division, Great Lakes Steel Corp.) and Marshall Holt (Aluminum Co. of America). As compared to riveting and bolting, welding can markedly change the dimensions, hardness, tensile strength and other properties of the base metal, and this basic fact must always be kept in mind said Mr. Bibber. Mr. Collins described the progress being made in design procedures for light-gage metal frameworks, and Mr. Holt a series of tests on end connections of tubular aluminum members.

***Flood Fighters**—Preparing for a $10,000,000 program of building dams to impound water at headwaters of streams, members of the new Pennsylvania State Flood Control Commission meet at Harrisburg. Left to right are: Rep. R. P. Stimmel, Allentown; E. M. Schumo, Hamburg; M. F. Draemel, secretary of forests and waters, and Rep. Albert E. Madigan. Mr. Draemel's department will act as an advisory agency to the commission on its program.*

Confirm directors of housing agency

Congressional affirmation of Presidential appointments to make up the board of directors and staff of the Housing and Home Finance Agency last week completed organization of that body.

Temporary appointments were made by Mr. Truman when the agency was formed in July 1947, pending Congressional approval.

The appointments are: Raymond M. Foley, administrator; Franklin D. Richards, commissioner, Federal Housing Administration; John T. Egan, commissioner, Public Housing Administration; and William K. Divers, J. Alston Adams and O. K. LaRoque, members of the board.

Seek engineer staff for new Bay crossing

Design engineers for bridges and subaqueous tunnels are urgently needed by the new Division of San Francisco Bay Toll Crossings, Ralph A. Tudor, chief engineer, said last week. The division (*ENR* Jan. 8, vol. p. 29) must determine suitable sites and foundations for the two proposed new toll highway crossings between San Francisco and Alameda counties, as well as design the structures and approaches.

Engineers qualified to fill the positions erected by the formation of the Division, particularly design engineers for bridges and subsequeous tunnels, are urged to write for full information to Division Headquarters, Room 500, 74 New Montgomery St., San Francisco.

River experts study sedimentation problems

Six nationally known authorities on stream sedimentation, selected by Maj. Gen. Lewis A. Pick, Missouri Division engineer, recently held a 3-day conference with engineer officers at Omaha.

Those serving on the advisory board are: L. B. Straub of the University of Minnesota; E. W. Lane of Denver, consulting engineer; V. A. Vanoni of the California Institute of Technology; H. A. Einstein, son of the noted physicist, of the University of California; and G. A. Hathaway, special assistant to the Chief of Army Engineers, Washington, D. C.

Set date for underground bomb test

Army engineers plan to begin a five-month series of tests on June 1 to determine the destructive effects of huge explosive charges of TNT on underground structures in various types of soil and rock, Lt. Gen. Raymond A. Wheeler, Chief of Engineers, announced last week.

The experiments are designed to establish design criteria for future structures and tunnels able to withstand modern bombs and guided missiles. No atomic bombs will be used in the tests.

Initial tests will be made at the Dugway proving grounds near Salt Lake City, followed by later tests there and in the vicinities of Castledale, Utah, and Grand Junction, Colo.

Surveys and planning for the tests have been underway since last September (*ENR*, Oct. 2, 1947, vol. p. 439). Structures will be tested in four types of soil and four types of rock common to the various sectors of the United States. The soils are dry sand, wet sand, dry clay, wet clay; the rocks are granite, sandstone, limestone and shale. Tests in the four soils and in limestone will be at Dugway proving grounds; in sandstone and shale near Castledale; and in granite, near Grand Junction.

Aimed primarily at determining requirements for command posts, air defense control centers and other vital military installations, the experiments will also develop criteria for protecting underground industrial plants. The explosive charges will be placed below the ground surface at depths equivalent to the penetration of bombs and missiles.

Explosions of four sizes with definite scale relationship will be used. Test structures in soil and tunnels in rock will correspond in scale to the size of the explosive charges. The charges to be exploded are: 1/10 scale, 320 lb. of TNT; 2/10 scale, 2,560 lb.; 5/10 scale, 40,000 lb.; and full scale, 320,000 lb.

Charges of the two smaller sizes will be applied to all the testing sites. The 40,000-lb. explosion will be set off in all types of soil and rock except wet sand. Use of the heaviest 320,000-lb. charge will be confined to dry sand, dry clay, granite and limestone formations.

Technical direction of the tests is assigned to the office of the Chief of Engineers. The district engineer at Sacramento, Calif., supervises field operations. Contractors already are busy on preliminary work. (*ENR* March 18, vol. p. 400).

A board of consultants has been established to assist in planning the tests and analyzing the results. This board includes Professors John B. Wilbur and Charles H. Norris, of the Massachusetts Institute of Technology; N. W. Newmark, of the University of Illinois; C. W. Lampson, of the Army ordnance department; L. Don Leet, of Harvard; Leonard Obert, of the Bureau of Mines; Professor C. W. Livingston, of the Colorado School of Mines, and technical specialists within the ranks of the Corps of Engineers.

RAIN MAKING ON A BUSINESS BASIS

Weath-Air Inc., rain-making service recently formed by Paul Mantz in Los Angeles, Calif., has signed a contract with the Salt River Valley Water Users Association to produce rain for the drought-stricken agricultural area around Phoenix, Ariz.

At present the Water Users Association is Weath-Air's only client but Mantz says that three southern California cities, a dozen large cattle operators and a resort are interested.

Proposals to cities are made on the basis of a flat fee for each flying hour guaranteed plus an additional sum per acre-foot of new water added to the city's reservoir.

Reserve group approves army research program

A committee of scientists and engineers who held commissions in the Organized Reserve Corps, met in Washington, D. C., March 26-27 to consider details of the Army's newly-proposed research and development program for reservists.

Meeting under the sponsorship of the Research and Development Group, Logistics Division, General Staff, the committee unanimously approved the program and submitted a report strongly recommending its immediate establishment.

Headed by Brig. Gen. Norman W. Lack (Eng. Res.), of Wilmington, Del., the committee included representatives of various aspects of research and development, both governmental and industrial; organized scientific societies; and educational institutions. Among them were: Col. C. E. Davies (Ordnance Res.) secretary of the American Society of Mechanical Engineers and Col. W. N. Carey (Eng. Res.), executive secretary of the American Society of Civil Engineers.

Deficiency bill provides added construction funds

The first deficiency appropriation bill for 1948, recently passed by the House of Representatives (*ENR* April 8, vol. p. 537) supplies construction money for several agencies in addition to the Atomic Energy Commission.

The Territory of Alaska is assigned $7,370,000 in cash and a contract authorization of $4,000,000 for construction of roads, while the Bureau of Indian Affairs is listed to receive $716,000 for a hospital at Sitka.

Recommendations for the Corps of Engineers total $2,865,000, including $1,600,000 for construction on the St. Lucie Canal in Florida.

Contract authorizations of $4,100,000 are set up for the Navy's Bureau of Yards and Docks.

House OKs highway bill for half-billion yearly

The House of Representatives this week passed the Federal-Aid Highway Bill for 1948 (H.R. 5888) authorizing $500,000,000 of federal aid funds for each of the three fiscal years, 1950, 1951 and 1952 (*ENR*, March 25, 1948, Vol. p. 451). The measure has gone to the Senate, which is expected to approve.

Money appropriated under the bill will be apportioned in accordance with the formulas contained in the Federal-Aid Highway Act of 1944. Each $500,000,000 of yearly aid, $225,000,000 is for projects on the federal-aid primary system, $150,000,000 for secondary and feeder roads, and $125,000,000 for federal-aid systems in urban areas.

By a provision of the new bill, money apportioned for any one year to a state will be available for three years following, an extension of one year over the grace period now in effect.

A section of the bill provides that "secondary and feeder roads" shall include county and township roads and that state highway departments shall cooperate with township trustees and other local road officials in selecting the roads in this classification on which funds shall be expended.

The bill also authorizes for each of the three fiscal years $25,000,000 for forest highways; $12,500,000 for forest development roads and trails; $4,250,000 for national park roads; $10,000,000 for highways leading to national parks; and $6,000,000 for Indian reservation roads.

Sufficient funds are available to the states from previous appropriations to maintain an active construction program through fiscal year 1949, until the new authorizations become effective.

OBITUARY

Colin M. Ingersoll, 89, a consulting engineer who participated in the early development of the New Haven Railroad and once served the New York City government as a bridge traffic expert, died at Salisbury, Conn., April 7. He was graduated in 1880 as a bachelor of science from Sheffield Scientific School, Yale University, and began his long railroad career with the Missouri Pacific Railway at St. Louis. A short time later he joined the New Haven. Before he left the road in 1906, he had charge of double-tracking its shore-line, helping lay out and construct its 4-track line from New Rochelle to the Harlem River. He served in 1892, as city engineer for New Haven, Conn., and in 1895 as chairman of that city's Harbor Commission. From 1897 to 1900 he was president of the Union Freight Co and the Old Colony Steamship Co. in Boston. From 1900 to 1906 he was chief engineer of the New Haven.

Francis A. McNamee, 47, a civil engineer for the Washington, D. C., Highway Department for the last 27 years, died there March 28.

John Marshall, 54, for 10 years safety engineer for the U. S. Engineers at Louisville, Ky., died there April 1. He had formerly been with the government engineers in Columbus, Ohio.

Horace C. Botsford, 70, died in Kansas City, Mo., March 29. He had been county engineer of Riley County, Kan., and later became a general highway construction contractor.

Allan W. Carpenter, 75, of Johnstown, N. Y., formerly engineer of bridges for the New York Central Railroad system, died in Yonkers, N. Y., April 9. He was with the Central from 1900 until he retired in 1943. He was a graduate of the former Case School of Applied Science in Cleveland, Ohio.

Walter M. Cullen, 51, city engineer of Prairie du Chien, Wisc., since 1941, died at Dubuque, Iowa recently.

Charles R. Hill, 81, retired Toledo, Ohio, civil engineer and surveyor, died in that city April 6.

Lester A. Bridges, 62, Newburyport, Mass., chief engineer of the Newburyport Water Works for 22 years, died April 8.

Charles E. Lambert, 52, an assistant city engineer of East St. Louis, Ill., died April 6. He formerly had worked for the East St. Louis park district and the Illinois highway division.

Frank B. Lessman, 53, highway engineer in the western headquarters office of the Public Roads Administration, and with the PRA for 29 years, in San Francisco, died in Ogden, Utah, April 6.

Blakely Mt. Dam tunnel contract bid $4,446,155

United Concrete Pipe Corp. and Associates—Ralph A. Bell, Stolte, Inc., and Charles A. Harney—of Oakland, Calif., were low bidders for construction of tunnels and appurtenances for Blakely Mountain Dam, on the Ouachita River northwest of Hot Springs, Ark.

Col. John Trescott, resident engineer at Hot Springs, said the low bid was for $4,446,155.

Work on the construction of the tunnels is expected to be started this spring. The over-all cost of the project is estimated at $22,000,000, to provide the retention of flood waters and the generation of electric power. The lake to be created will cover approximately 40,000 acres at maximum power pool level.

Construction of the spillway for the project, started last summer, is expected to be completed in June of this year.

MAJOR MEETINGS

Building Officials Training School, Drake Hotel, Chicago, Ill., April 26-29.

American Wood Preservers' Association, 44th annual meeting, Hotel St. Paul, St. Paul, Minn., April 27-29.

State Sanitary Engineers, Annual conference with Public Health officials, Washington, D. C., April 26-30.

National Public Housing Conference, Inc., Hotel New Yorker, New York, N. Y., May 3-5.

American Water Works Association, 1948 conference, Atlantic City, N. J., May 3-7.

Second Highway Transportation Congress, Mayflower Hotel, Washington, D. C., May 6-7.

Canadian Association of Equipment Distributors, General Brock Hotel, Niagara Falls, Ont., May 10-12.

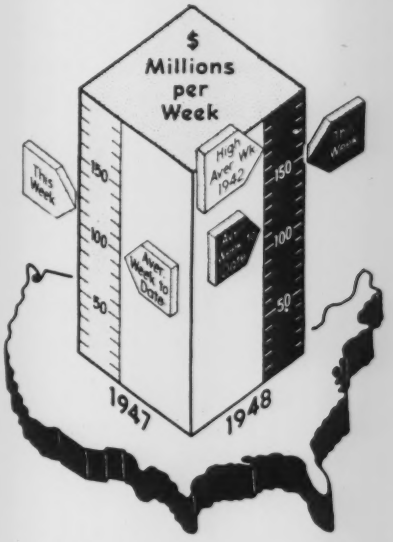
Society for Experimental Stress Analysis, The Roosevelt Hotel, Pittsburgh, Pa., May 27-29.

National Conference of Community Planning, annual meeting, Banff Springs Hotel, Banff, Alta., June 2-5.

American Society for Engineering Education, 56th annual meeting, University of Texas, Austin, Tex., June 14-18.

American Society for Testing Materials, annual meeting, Detroit, Mich., June 21-25.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Apr. 15 1948	Cumulative 1948 (16 wks.)	Cumulative 1947 (16 wks.)
Federal	$12,549	$347,207	$142,828
State & Mun.	42,944	628,633	445,302
Total Public	$55,493	$975,840	$588,130
Total Private	89,086	906,017	965,797
U. S. Total	**$144,579**	**$1,881,857**	**$1,553,927**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1948 (16 wks.)	Cumulative 1947 (16 wks.)
Waterworks	$4,628	$49,766	$41,841
Sewerage	7,470	56,930	28,685
Bridges	2,022	84,226	45,563
Highways	16,582	237,654	186,220
Earthwork, Waterways	2,039	156,937	74,590
Buildings, Public	17,360	324,279	151,924
Industrial	34,165	301,773	250,223
Commercial	52,625	526,818	592,176
Unclassified	7,688	143,472	182,705

NOTE: Minimum size projects included are: Waterworks and waterway projects, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (16 wks.)	Cumulative 1947 (16 wks.)
NON-FEDERAL	$1,011,506	$193,655
Corporate Securities	586,589	184,438
State and Municipal	424,917	369,217
Total Capital	**$1,011,506**	**$193,655**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Apr.'48	438.50	210.79
Building Cost	Apr.'48	329.42	178.07
Volume	Mar.'48	250	110

EDITORIALS

VOLUME 140 NUMBER 16

April 15, 1948

Sanitary Engineers For the Atomic Age

As WITH EVERY INDUSTRY, the business of atomic-energy production also has a waste-disposal problem. Some idea of its magnitude may be gained from the article published on p. 68 of this issue, which reviews activities under the atomic energy program. One of the "wastes" from plutonium production is tons of a mixture of working chemicals, water, uranium and fission products, the latter possessing intense radio-activity of long life. At present, this deadly material is stockpiled for later extraction of uranium, but leakage could contaminate the water supply of an entire region. Another possible hazard may be created by careless handling of radio-active isotopes that are now being distributed to research agencies; should these be inadvertently turned into sewers, they could conceivably create a new kind of stream pollution. It is gratifying to report, therefore, that leaders in the sanitary-engineering profession are not unaware of these implications, and they have participated in discussions with the Atomic Energy Commission with a view toward the development of safeguards. Many questions, of course, must remain unanswered until further information concerning treatment methods, test procedures, and human-tolerance limitations is obtained. But in this pioneer venture of greatest significance to public health, sanitary engineers are peculiarly equipped to render a great service. It is to be hoped that they and their skills will be applied on the broadest scale to one of the most complex problems of our Atomic Age.

Inspection of Structural Welds

A PROPOSED REQUIREMENT that every welded steel joint in California school-building construction be X-rayed for flaws does not seem to be practical. First, it is doubtful that test by X-ray or magnaflux will result in accurate conclusions. Varying thicknesses and angularities of welds in a structural joint make these tests difficult as compared with similar tests on uniform welds. Besides, there seems to be no reason to question the structural adequacy of work performed by qualified welders when the work is subjected to visual examination by an experienced inspector. Cost is another consideration. In many cases the tests would cost more than the original weld. More important, however, is the fact that such a ruling would indicate a lack of confidence by reviewing officials in welded construction. Only when structural engineers and building officials develop proper trust in welding can best use be made of this effective method for building construction.

Wanted: Highway Engineers

IT WILL BE of little comfort to the state highway official already harassed by an alarming shortage of engineers to learn from a recent AASHO survey that less than 18 percent of civil-engineer graduates this spring contemplate entering the highway field. And most of these say they may do so only if wages paid in highway work are comparable with those offered by private industry. This report crystalizes the admonition of leaders in the industry who have urged that steps be taken to prevent a manpower shortage within state highway departments. As pointed out recently by Hal Hale, executive-secretary of the AASHO, increased salary scales will not alone solve the problem. A little well-directed romanticizing of opportunities in highway work—through movie "shorts" and other publicity media—might prove more profitable than flat-rate comparison with wages paid in other engineering fields. Young engineers should also be made acquainted with certain attractive features of employment in a state highway agency, such as civil service benefits, all coupled with broad opportunities for advancement in an ever-expanding field of endeavor. Indoctrination with these facts prior to graduation would stimulate interest in a highway career.

More Sensible Specifications

THE MOST thought-provoking paper presented at last week's Spring meeting of the ASCE in Pittsburgh was written by a contractor. In itself, this fact is not so unusual these days when many contractors are themselves engineers, but rather it is significant for that reason. Today, contractors are beginning to think like engineers are supposed to think—in terms of what is good for the owner. One thing that would be good is lower costs, and the contractors have an idea they could get them, with some cooperation from the engineer. Dwight W. Winkelman, contractor of Syracuse, N. Y., and

currently president of the Associated General Contractors, posed the proposition in the paper referred to above. It is simply that engineers, and particularly those who determine specifications, "eliminate non-essentials and fineries for appearances sake", and direct their requirements toward results that can be attained with machines instead of hand labor. In developing this theme, Mr. Winkelman focused a spotlight on one of the most glaring faults in present-day engineering procedures. Engineers have taken some pride in the definition of an engineer as one who can do with one dollar what anyone can do with two. Some of the specifications that engineers put out raise a doubt that the definition always has a basis in fact. Who is guilty? Practically everyone —federal agencies, state highway departments, municipal public-works offices and private consulting engineers. Why not examine our specifications to see if they are sensible and in the owner's interest?

Economic Cooperation

WHEN PRESIDENT TRUMAN on April 3 signed the Foreign Assistance Act of 1948, there emerged a term that is for the first time descriptive of what has been variously known as the Marshall Plan, the European Recovery Program, the foreign-aid plan, aid to Europe and China, foreign relief and rehabilitation and other equally indefinite and vague appellations. This new term is the Economic Cooperation Administration. And it refers to the organization that will be set up to handle our contribution to world recovery under the plan proposed ten months ago by Secretary of State Marshall.

Economic cooperation expresses accurately the objective sought and the job to be done. Military cooperation could follow, of course, but it is not included in the present bill except for China; the Greece and Turkey military aid antedates the bill and is separate from it.

That it was to be a cooperative enterprise was plain from the beginning when Secretary Marshall proposed to the European nations that they get together, determine their reconstruction requirements, and agree on their collective ability to satisfy them by self-help and cooperative action. On our part, we would then attempt to supply the deficits with goods and dollars.

Sixteen nations accepted the challenge (Russia and the countries she controls refusing), and entered on a collective cooperation that has clearly shown their will to succeed. Now, the U. S. has come through with its part of the bargain, and the family of cooperators is complete.

The impact of the program on engineers and construction men is twofold. As American citizens concerned with world recovery on a free, democratic nation basis, they have an obvious stake in its success; indeed such success is the only weapon that we hold against Russian expansion short of war. And as construction specialists, they will feel the impact in their business lives—through being asked by the Economic Cooperation Administration or one of the European countries to aid in the actual reconstruction operations, or through adjustment to shortages of equipment or materials at home.

The responsibilities that these impacts will cause are not unfamiliar, since they are similar to those that were shouldered during the war. Moreover, assuming such responsibility today is not unlike what it would be in wartime, considering Russia's pressing and belligerent attitude. The difference comes in accepting this fact, in recognizing the new position of world leadership in which the U. S. finds itself, and in realizing that this leadership can only be made effective by the attitude and actions of individual Americans.

The economic cooperation promised by the Foreign Assistance Act is a great test of that leadership. For the general world good, we are frankly subsidizing and building up competition for ourselves in world trade. We are supporting inflationary forces in our own economy. We are increasing our tax burdens. And we are helping to improve harbors, rebuild industrial plants and houses and construct hydro-plants, railways, highways and bridges in other countries, with probable postponement of similar activity at home.

In the unselfishness of such a program rests our greatest present strength and justification for leadership. In the enlightened self-interest of such a program, on the other hand, resides our best hope for a future peaceful world in which we can continue to deserve and enjoy that leadership. Both in developing a mature national attitude toward our responsibilities, and in applying it to present world conditions, engineers and construction men have a prominent role to play.

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Atomic Energy Commission

Construction camp at North Richland, Wash., for the expansion program now being carried out at the Hanford plant.

Behind Our Atomic Iron Curtain Big-Scale Construction Goes On

Robert Colborn
McGraw-Hill Bureau
Washington, D. C.

***Editor's Note**—During recent weeks the author of the following report, who is a former member of the editorial staff of Engineering News-Record, visited every major atom plant and laboratory and made an exhaustive study of the atomic energy operations and plans of the United States government as the basis for a report that would bring to readers of McGraw-Hill publications the most authoritative report that could be prepared without access to secret information. Before completion, the report was submitted to the Atomic Energy Commission for review and now has been released. Those parts of Mr. Colborn's report that are of most direct interest to the readers of the journal such as the probable magnitude of the construction work required for the present program are given in the following, together with Mr. Colborn's review of what has been accomplished to date and his observations as to probable future developments.*

Is AMERICA's atomic-energy program stagnating? Is America moving ahead on atomic energy? How fast? In what direction?

For the citizen trying to form an intelligent answer to these questions, the facts are extraordinarily hard to come by. The information that anyone would naturally ask for first—on production rates, resources, and the like—is all stamped top secret. Even the nature of the problems ahead, the technical reasons for policy decisions and the terms of contracts are obscured if not hidden by secrecy requirements. But for men interested primarily in the construction aspects of the atomic-energy program this is apparent. New construction authorized by the Atomic Energy Commission and already under way at the Hanford plant on the Columbia River in Washington will be the most costly construction operation ever undertaken in peacetime.

The atom management's number one job, of course, is to keep the war-built plants running, to maintain the bomb production achieved by the Manhattan District.

This concentration on weaponeering inevitably has a retarding effect

on civilian applications. The most immediate application—production and distribution of radioisotopes—doesn't compete seriously for material or engineering talent.

But application of the atom's power to non-destructive uses does definitely compete for both material and talent.

The quick plant

The first plant to deliver appreciable quantities of explosive was the electromagnetic plant (coded as Y-12) at Oak Ridge, then operated by an Eastman Kodak subsidiary. This plant contains a large number of machines, calutrons, each of which is capable of producing U235.

The calutron is a modified and overgrown mass spectograph. Uranium is ionized—broken down into electrically charged molecules—and the ions are shot at high speed past a tremendous magnet which deflects them to one side. The U235 ions are deflected more than the slightly heavier and non-explosive U238. They come out at a different place, therefore, and can be collected separately.

This sounds nice, but unfortunately no one has yet figured out how to ionize the uranium in any quantity. Hence each individual machine has a low output, the power consumption is very high, and the manpower required to produce a pound of material is all out of proportion with alternative methods.

So early last year, large scale production at Y-12 was halted. Most of the plant is being held in standby. Some of the calutrons are still being operated experimentally in an effort to find a way around the naturally low efficiency of the process. Several others have been converted to separate naturally occurring isotopes of other elements than uranium; these are useful for scientific tracer work in much the same way as the better publicized radioactive isotopes.

On this basis, the plant is being looked after by Carbon & Carbide Chemicals Corp., a Union Carbide subsidiary which now operates all the major facilities at Oak Ridge.

The successful plant

The second and best known of the U235 plants is the gaseous diffusion (K-25) plant at Oak Ridge. It is believed to be the largest industrial operation ever carried on under one roof. Its construction involved an almost endless list of fantastically difficult and unprecedented industrial problems: in pumping, in corrosion resistance, in welding techniques, in high vacuum, in leak detection, in instrumentation, and so on. It cost a billion dollars to build. It's the only one of its type in the world. And in all probability there will never be another one like it.

In this plant, uranium combined with fluorine to form a gas, is forced through stage after stage of sieves, barrier membranes—thousands of stages. The light isotope, U235, the fissionable one, goes through the sieves a little more easily than the heavier U238. So what comes out at the far end is enriched U235.

K-25 has been by far the most successful of the atom plants. Almost from the start it ran without serious difficulties. Nevertheless AEC feels that technically K-25 is a blind alley.

For one thing, K-25 is the most expensive and difficult to build of all the plant types. More important, it is intrinsically wasteful of nuclear fuel. It extracts the naturally fissionable 0.7 percent from uranium and discards the rest.

The Hanford process, on the other hand, offers the promise of utilizing the plentiful kind of uranium, U238, by transmuting it into the artificial, and fissionable, element plutonium.

So there are no plans for additional facilities of the K-25 type. But K-25 itself will be kept running indefinitely, certainly as long as accumulation of bombs has a top priority. And even after that, there'll be uses for concentrated U235. Production of enriched fuel, for instance, for certain types of reactors. And there are hints that the uranium bomb is in some ways superior to the plutonium bomb.

Meanwhile, the K-25 process has been pretty steadily improved since the end of the war. The result is that output of U235 has been substantially increased. At the same time, labor requirements have been greatly reduced —from a peak operating force of 12,000 down to a present 5,200.

The promising plant

No such postwar increase in output has been achieved at the third explosive plant—the Hanford Engineer Works. As a matter of fact it is a technical miracle that production has been held up to the wartime level—as it has been.

Where K-25 applied fairly well established industrial principles, even though at a level of extreme complexity and difficulty, the three Hanford units utilize processes that had never occurred on earth until December, 1942.

The designers of the three Hanford piles had only one motive: to make enough plutonium for a bomb. If the piles continued to operate afterwards, so much the better. But they weren't wasting much thought on that question. Few of them, probably, would have bet that the piles would still be running in 1948.

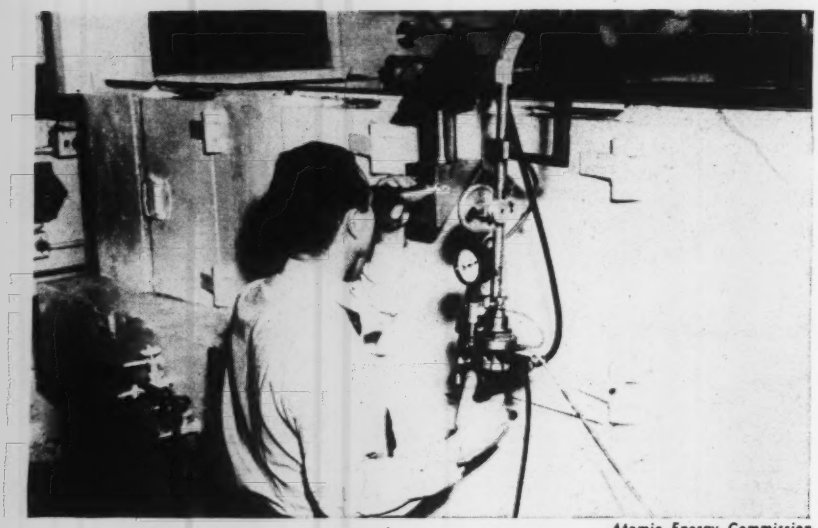
Shortly after the chain reaction in the first pile was turned on there was one terrible day when the reaction simply died away, spontaneously. Fission products—pieces of split uranium atoms—were "poisoning" the pile. In what has been described by people who were there as the most brilliant single feat of engineering they know of, the trouble was diagnosed and a solution found within a matter of hours.

Different methods used

The Hanford process strikes out on a completely different tack from Oak Ridge's. No effort is made at the tough separation of U235 from U238—isotopes which are chemically identical and offer only a tiny weight difference to work on. Instead, the U235 is "burned up" in a chain-reacting pile. In its burning, it transmutes a little of the inert U238 into another element, plutonium. This never is found in nature. It is fissionable. And, most important, it differs chemically from uranium. So then the plutonium can be separated by comparatively straightforward chemical methods.

Each of the Hanford piles is essentially a stories-high block of very pure graphite encased in some feet of concrete shielding. Into this block are inserted slugs of metallic uranium sealed into aluminum cans to protect them from corrosion. Because the pile is big (above critical mass), and because the graphite acts as a moderator (slowing the neutrons emitted in fission) a fission chain reaction takes place in the U235 content of the uranium.

After a while, the uranium slugs



Atomic Energy Commission

From behind heavy walls and a protective lead shield an operator in the "hot lab" at Hempstead, N. Y., uses a hydraulic manipulator to control operations which are observed through a periscope.

are removed. They're dissolved in acid and put through a series of precipitations and resolutions which finally separate out the plutonium—the end product of the process.

Water contamination problem

The plutonium leaves a problem behind it—in the form of tons and tons of a mixture of working chemicals, water, uranium, and fission products. These last possess radioactivity which takes years to die away and is so intense that they contaminate the whole mass to the point where it has to be handled from behind lead or concrete walls.

At present this deadly mess is simply stockpiled for later extraction of uranium. But proper storage is tough. Leakage could contaminate the water-supply of a whole region, but AEC is confident that the measures it takes obviates any danger. The solution seems to lie in more complete chemical treatment of the pile output, treatment which would separate out the fission products. These add up to a matter of pounds rather than tons, and their disposal wouldn't be so frighteningly difficult.

Big construction problem

Despite all its difficulties, the plutonium process is the one on which everyone banks for the future. So AEC has started a tremendous expansion at Hanford as its major move to step up bomb production.

But the really big job is construction at the Hanford site of a complete new plutonium plant. It'll be bigger—or at least more expensive—than the existing plant and will presumably have a larger production capacity. Eventual cost will be something between $300 and $500 million—*making it the biggest single construction job undertaken in peacetime.*

The new plant isn't going to differ fundamentally from the old one. It'll use fairly conventional graphite-moderated piles with natural, rather than enriched uranium. Most important, the piles will run cold rather than at a high temperature which would permit utilization of their tremendous power output—even though this means throwing another million kilowatts into the Columbia River.

The designers are taking no long jumps comparable to the wartime jump from a 300-watt pile at Chicago to the Hanford piles that operate, it has been estimated, at something approaching a half-million kilowatts. They are introducing more new features this time than, say, a progressive oil company would be likely to introduce in designing a new refinery, but not too many more.

On this job, AEC's over-riding objective is a quick sure increase in plutonium production with no chances taken. Advancement of the nuclear art is a very, very secondary objective.

Construction of the new plant at Hanford was one of the first decisions made by the atomic energy commissioners when they took over from the Army. But through much of last year, the project was seriously bogged down.

Much engineering involved

General Electric had just taken on the operation, succeeding duPont, which had designed, built, and operated the plant during the war. GE inherited a crack operating staff from duPont; nearly every man elected to stay with the project when the transfer was made. But GE inherited no engineering staff. In the duPont tradition, Hanford was designed by the central engineering force at Wilmington.

Thus GE had to assemble an engineering force at Hanford at the same time that it tackled one of the biggest design jobs in history. Good engineers are hard to come by these days. And all through last summer, AEC kept scaling up its ideas about the size of the plant.

But last September the bottleneck was broken. GE subcontracted the design of the chemical separation plants to M. W. Kellogg, which organization designed K-25 at Oak Ridge. At the same time another contract was placed with The Standard Oil Co. (N. J.) to work out alternate designs for several particularly tricky phases of the chemical plants. Still a third alternative is being explored by the Clinton Laboratory at Oak Ridge.

Today design is well advanced. The Guy F. Atkinson Co.-J. A. Jones Construction Co., GE's construction subcontractors, already have preliminary work under way. By the end of the year construction will be going full blast, and it will continue at a high rate until it begins to taper off in 1951.

Material procurement for the new plant is already moving. This is proving, in many ways, to be more difficult than it was during the war. In those days the atom project had an over-riding priority. Today it has no priority at all.

Curiously, it isn't the tricky special items that cause the trouble. The unique utterly special equipment is being obtained fairly easily from the same people who furnished it during the war.

Where the trouble comes is in get-

ting standard stuff—steel (of which some 54,000 tons will be needed), lumber, cement. Some idea of the quantities involved can be gained from the statistics on the present plant, which required 25,000,000 cu. yd. of excavation, 780,000 cu. yd. of concrete, 160,000,000 board-ft. of lumber, 232 miles of pipe.

Regular industrial supply lines into the Northwest just aren't able to absorb quantities like these. In some cases the purchasing agents have had to resort to the grey market.

Morale on the Mesa

Los Alamos Scientific Laboratory, perched on the flat top of a mesa in northern New Mexico, is the plant for actually manufacturing bombs from the explosive produced at Hanford and Oak Ridge. And so far, Los Alamos looks like the weakest spot in AEC's program for more and better bombs because until a month or two ago, no definite research program had been worked out for Los Alamos, either by AEC or by the Army before it. The whole responsibility for the direction of weapon work rested on the men on the mesa.

And that responsibility fell on an organization in poor shape to handle it. Like every war agency, the atom project suffered a considerable exodus of its best men at war's end. But nowhere was this more marked than at Los Alamos.

Nor were living and working conditions good. Alone among the atom centers, Los Alamos is still wading around in the mud. It was originally conceived of as a small site for a few dozen scientists. It's growth constantly outstripped the plans for it. And today, with a population of about 8,000, the mesa top is a mad jumble of prefabs, log cabins, sheds with lean-tos, and sheds with lean-tos on the lean-tos.

AEC is making a vigorous effort to attack the trouble at its sources. Its new program provides for devoting about a quarter of the laboratory's resources to basic research to make the place more professionally attractive.

A building program, to replace the makeshift housing with modern houses in a charming version of southwestern architecture, complete with shopping and recreation centers, is being pushed at top speed (so fast, in fact, that quite a few of the houses collapsed the first time is snowed; but a speedy demonstration of improvements to come seemed essential to morale). Within a year or two Los Alamos will be an almost luxurious resort-type town.

Architectural and engineering work on the new houses and community centers is being done by Architects and Engineers, Inc., a new firm organized by W. C. Kruger of Santa Fe, N. M. Construction work is being done by the Robert E. McKee Construction Co., and a subsidiary Zia Co., operates the town.

Development of power

The key fact about development of useful power from atomic energy is that no one in the United States needs atomic power very badly.

What atomic energy could provide in the near future, most technicians guess, is a practically unlimited source of electric power which would be a little cheaper, perhaps, than power from coal, more expensive, almost certainly, than hydro-electric power. Its most peculiar economic characteristic would be that, as far as fuel is concerned, it would cost about the same anywhere—on top of the Andes or in New York City; the plant manager could bring the day's fuel to work in his briefcase.

To a nation which possesses a 2,000-year reserve of coal, such a prospect is not terribly exciting—economically speaking—to anyone outside the fuel business. Conceivably, it might change the cost factors in plant location of some U. S. electro-process industries—moving them closer to raw materials or markets. However, the University of Chicago's Cowles Commission, which has been making a study of transportation-free 4-mill power, thinks not.

It is considerations like these rather than technical factors which set the time scale for useful atomic energy. You can find competent technical people who are confident that on a work-it-out-as-you-go-along engineering basis they could deliver you, if you wanted it, a commercial-size reasonably-economical power plant along about 1952.

But the AEC doesn't want it much. The commission is scheduling its power work to produce an economic plant sometimes around 1960. Throughout the sixties it looks for steady installation of additional plants, so that by 1970 atomic energy might be supplying 20-25 percent of the country's power needs.

The rest of the world, however, is not likely to be so casual about power possibilities. The Cowles Commission thinks that on the central European plain—the Balkans and western Russia—there's a combination of developed industry, fuel scarcity, and expensive transportation that would make atomic power attractive.

The coal-starved British, who have budgeted about $120 million for atom work, are believed to be stressing power development in their program.

So the first substantial power plants may appear outside the United States.

The one exception to U. S. indifference about power plants may turn out, curiously enough, to be the Air Forces. When you remember that today's heavy bombers carry as much as 40 tons of gasoline this doesn't seem as fantastic as it does at first glance.

Power plants in the offing

The only nuclear reactor in existence today which is capable of delivering its energy output in usable form is the fast neutron reactor at Los Alamos, N. M. This unit is fueled with pure plutonium, employs no moderator, is essentially a controlled bomb.

This reactor, which went into operation in November, 1946, delivers its energy at a fairly high, and therefore useable, temperature. It is described at Los Llamos as "a watch-charm model of a power plant." Its primary purpose is the study of bomb physics, but it is producing information which will be valuable if, as some expect, practical power plants turn out to resemble bombs more than they do the huge Hanford piles.

The second high-temperature pile due to come in is one at Brookhaven National Laboratory on Long Island, which is now under construction and should be completed next year. This may actually deliver a little electric power; AEC hasn't decided yet.

The Brookhaven pile is simply a quickly-designed tool to produce neutron beams and perform irradiations. It is pretty much a copy of the existing pile at Oak Ridge—air-cooled, carbon moderated, fueled with na-

tural uranium. However it will operate at a higher power level than Oak Ridge's 1000 kw. and its cooling air will emerge hot enough to generate steam. The limit on its temperature is the heat-resistance of the aluminum jackets which protect the uranium from corrosion.

Space is being left in the design for a heat exchanger. But any power generated won't even be enough to run wind-tunnel-size blowers that force cooling air through the pile.

A possible pilot plant

The first reactor that can reasonably be considered a pilot plant for power generation is the Zinn pile at the Argonne National Laboratory in Chicago Construction work on this only awaits final AEC approval. As a matter of fact, Argonne was ready to start a year ago. This will take a year and a half to two years to build.

The Zinn pile's primary purpose will be research, but it is being designed to do a workmanlike job of getting the power out in usable form. It will be a fast-neutron reactor using concentrated fuel, will operate at a fairly high power level and at a temperature comparable to that of a modern steam plant.

Two reactors specifically designed to produce electric power are on the AEC docket, but neither is in a very active condition. One is the Daniels pile, first projected by the Manhattan District in 1946 and then scheduled for completion this year. Like the Brookhaven pile, it was intended to be a modification of the Oak Ridge pile, run at a high enough temperature to generate steam.

When AEC took over from the Manhattan District, it didn't think much of the Daniels pile, figured it was intended to produce publicity rather than knowledge. So this project has been in abeyance ever since.

The other straight power project is the General Electric reactor scheduled to be built at the Knolls Atomic Power Laboratory near Schenectady. No information has been furnished about this pile except that it will eventually run at a high enough power level to provide a practical demonstration of the operating problems to be expected in a commercial-size plant.

Design of the GE pile is now underway, but it is being held back by the expansion program at Hanford. The Knolls people have had to devote a large share of their attention to the research needs of the Hanford work, and it appears likely to be some time before construction of the pile can start.

During the past year a number of the technical problems standing in the way of power production have come close to solution.

On the problem of a heat-transfer fluid, of which much was heard a year ago, it now looks as if the Smyth report's suggestion of liquid sodium, alloyed with potasium to lower its melting point, would turn out well. Sodium doesn't absorb neutrons, does not become seriously radioactive, has good thermal properties. It does react violently with water. However a special heat exchanger has been developed—somewhat complicated but workable—to obviate trouble from this source.

Structural materials studied

Nor does the problem of structural materials for reactors now look as appalling as it did a year ago. Metallic titanium is being considered as a major load-carrying material which could resist pile temperatures which may eventually run, it is thought, as high as 2,000 to 2,500 deg. F.

AEC metallurgists are studying structural properties of a lot of unfamiliar metals such as beryllium and zirconium which in the past have been interesting mainly as alloying agents. Some of these have nuclear properties which make them valuable in themselves.

Some of this work is already producing valuable by-products. Discovery of ways to roll and extrude beryllium, for instance, has resulted in improved windows for X-ray tubes.

Similarly the elaborate chemical engineering studies involved in the design of the new Hanford plutonium plant are expected to work out separation methods basically applicable to power plants as well as to plutonium producers.

During the past year too, declassification of information on the breeding problem has clarified one fundamental question: is nuclear fuel so scarce that atomic energy must always be regarded as a special-purpose affair to be rigidly conserved? Or is it plentiful enough to be regarded as a major power resource?

Uranium itself is a fairly plentiful metal. However, only one part in 140 of it is naturally fissionable. If that were all, atomic energy would be a rarity very soon.

Fission adds to fuel supply

But when fissionable U235 is consumed in a reactor, producing power in the process, some of the U238 is transmuted into fissionable plutonium. This increases the potential supply of fuel.

Then the question is: when you burn a pound of U235, how much plutonium do you get? Suppose you only got half a pound. Burning that half pound would produce a quarter pound, and so on. You'd end up able to use only one part in 70 of the total uranium. Still not good.

But suppose you get a pound of plutonium out for each pound of fuel burned. Then you can eventually utilize all the uranium. And if you could get out more than a pound of plutonium, you'd have a "breeder pile" which would constantly produce extra fuel for use in other piles.

The same question applies to thorium, which is more plentiful than uranium. Exposed to a chain reaction, thorium is transmuted to fissionable U233. If at least one-to-one breeding is possible, this fact adds thorium to the potential energy supply. Otherwise it is just a scientific curiosity.

So what about breeding? Theoretically, it is possible: when a U235 atom splits, it throws out, on the average, something over 2.2 neutrons. One of these is needed to split another U235 atom and keep the chain reaction going. If another neutron is used to transmute a U238 atom into plutonium, that leaves a margin for losses—if the losses are small enough.

AEC's guarded comments indicate that in present piles the neutron losses are too great to permit breeding. But it is believed that the new piles now on the drafting boards would be efficient enough to breed fuel.

If it works out, that makes atomic energy a thousand-year resource or better. And people who like to worry about the fate of their descendents fifty generations away can take comfort from this thought: though there is no reason to look for coal or oil there, the moon should have lots of uranium and thorium.

Am. Wood Preservers Assn. photo

Fig. 1. The municipal pier at Flagler Beach, Fla., on creosoted piles, has withstood storms and borer attack for 23 years.

Finding and Fighting Marine Borers

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Part IV—Creosote Impregnation and Poisoning

***Contents in Brief**—Poisons and retardants applied to the wood or water are offered in many forms as borer repellants. Of these, creosote impregnation of the wood has attained material success and wide use. The materials and methods used, depth of impregnation and care in construction to keep the creosoted shell intact are important to success. This is the concluding article of a series of four, the first of which appeared in the March 4 issue. Reprints of the series are available.*

TREATMENT of the wood itself to retard marine-borer attack is very old. The Phoenicians painted their piles with tar or charred the surface. Only recently in Australia charring has been revived in the patented Carboteredo process, and strong claims are made for it. A surface coating of vaseline is applied and heated with a blow torch until fairly even charring has occurred to a depth of $\frac{1}{4}$ to $\frac{1}{2}$ in. Knots and ends are re-impregnated and hammered to consolidate the char at these points. Repairs may be made to cuts and damaged spots.

Treatment on a large scale began with the development of the creosote impregnating process a century ago. The first to propose creosoting was Franz Moll who took out a patent in 1836. Practical adoption of the process followed Bethell's patent in 1838. Over recent years, creosoting become the common method of poisoning the food supply of fungi, marine borers and termites. Consideration here is restricted to timber after it has been creosoted.

Life of creosoted timber

Prevalent heavy creosote treatments on cuts and framing connections as well as use of cant hooks and dogs, and the like after treatment have about doubled the life expectancy of wood piles. In many cases the increase has been much greater.

Creosoted piles above ground, pressure treated, have been estimated by the Forest Products Laboratory of Canada to have an average life of 35 years. Creosoted piles buried in

Fig. 2. Remnants of a speculative builder's untreated pier two miles from the Flagler Beach pier shown in Fig. 1. The pier failed after 6 months as a result of borer attack.

the ground should retain the preservative practically permanently if properly pressure-treated, and the laboratory estimates the conservative life of piles in the ground under masonry caps at 100 to 150 years. Cresoted piles for marine work can not be expected to reach the above efficiencies, but their life is lengthened considerably, provided oil of the proper composition is secured. All oils passing under the name of creosote are not equally effective.

Borer attacks will progress in creosoted piles, but at a slower rate. In the Pacific Islands, Gulf of Mexico and Caribbean waters an average life of 8 to 10 years is all that is expected. Considerably longer periods may generally be expected in colder waters, where the activities of marine borers are less violent. In San Pedro harbor the life is placed at 20 to 30 years, and in San Francisco bay at 15 to 25 years. Experiments at Gulfport, Miss., indicated that life in years at that point should be roughly equal to the number of pounds per cubic foot retention of creosote.

Danger points of attack

Creosote treatments do not protect the entire wood of the pile. The penetration of 1 in. to 1½ or 3 in. (depending on the wood) forms a rather fragile shell, with the interior of the pile as subject to attack as before. Any abrasion or puncturing of the shell invalidates the protection. In 1927 it was reported that 80 percent of all holes in creosoted piles through which borers had entered were caused by "dogging" the piles without plugging the holes. Once borers have gained access to the interior of a pile, destruction takes place rapidly. The effect of *Limnoria* attack is to honeycomb the surface, which permits loss of creosote and facilitates the entrance of shipworms. Checking of pile butts may permit *Limnoria* to enter. Use of large diameter butts and care in driving will help to avoid this.

Creosote treatment may not always stop damage by *Limnoria*, *Martesia* and *Sphaeroma*, which sometimes bore heavily into treated wood. If these are present they may damage the creosoted shell sufficiently to permit entrance of species of borers that would otherwise have been stopped.

Univ. of Calif. Public Zool. photo

Fig. 3. Bankia burrow through thin treatment ring, which permits other borer to penetrate.

The first point of borer damage is generally where the impregnation is thinnest, or where damage has occurred (Fig. 5). Loss of creosote by flow similar to leaching is most severe in thin spots. Thus, uniformity of treatment is important. The use of cant hooks, rafting dogs, dogs on shoes, or chain slings which may crush the fibers should be prevented on the part of the pile from a few feet below the mud line to 2 ft. above high water. Even a point of minute damage may permit entrance of a borer, which can then work in the pile without difficulty.

Framing or boring should be done prior to treatment as far as possible. Treated piles should not be cut for bracing, but treated filler blocks should be used. Bolt holes drilled in the field should be filled by pouring hot creosote through a funnel, or preferably by pressure equipment made for this purpose. Cuts should be well painted with two coats of hot creosote. Dipping bolts in sealing compound before driving, and coating the heads with sealing compound after driving, are good practice. The American Wood Preservers' Association's "Instructions for Field Treatment of Creosoted Timber and Piles" should be followed and incorporated into specifications for treated wood piles.

Most piles treated under pressure are southern yellow pine and Douglas fir. Experience has shown the economy of treating with heavy absorption all piles that are to be exposed under severe conditions, such as occur in the more temperate and warmer parts of our coastal regions. These provide a reserve supply of creosote to compensate for loss and insure deeper and more uniform penetration. Piles to be used in salt water where borers are active should be treated by the full-cell process to virtual refusals. The AWPA specify minimum absorptions of 20 to 24 lb. of creosote or creosote-coal tar solutions per cubic foot in southern pine where attack is known to be severe and 14 lb. of creosote per cubic foot in Douglas fir. The greatest absorption can be obtained in piles which have been air-seasoned.

Timber species found in the United States can almost all be treated suc-

cessfully with coal-tar creosote by standard impregnation methods. In coniferous or soft woods, the amount of sapwood should not be restricted, as it takes treatment more readily than heartwood. Hardwood piles to be treated should be limited to species which can be treated readily, such as the red oaks. There is practically no difference between the strengths of sapwood and heartwood, and from 1 to 3 in. of sapwood is preferable for treatment.

The usual creosote materials have little effect on the strength of piles. Frequently, however, green wood must be treated without waiting for air seasoning. It is customary to season green piles by applying steam at about 20 psi. (or 259 deg. F.) and then use a vacuum to remove 70 to 80 percent of the moisture in the sapwood. This treatment on green wood reduces maximum fiber stress values by about a third, though data on the subject is scarce and not conclusive.

Wm. F. Clapp photos

Fig. 4. Bolt hole in creosoted tender pile enlarged by action of Limnoria.

Fig. 5. Ferry slip piling attacked by Limnoria where creosoted zone was damaged by improper handling.

Retardants and palliatives

Creosote impregnation and pile encasement remain the dependable means of resisting marine borer attack. Invention, however, has been prolific in producing possible retardants and palliatives and some of these merit comment. In most instances the subjects can be dismissed briefly.

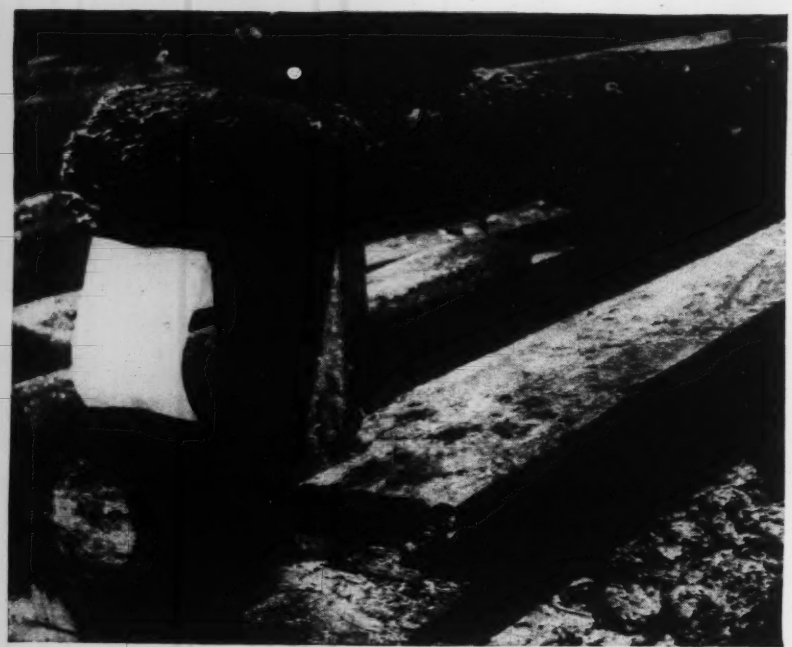
Immune woods: Experiments have not confirmed claims that certain woods are *immune* to marine borers, although some are certainly resistant to a great degree under certain conditions. Among such woods are greenheart in Europe and America, billian in the China Seas, turpentine wood in New South Wales, black cypress and titree in Queensland, spotted gum in Tasmania and teak in India. The only woods that show great resistance are a few tropical ones. In the tropics, such woods usually do not give as good service as in cool waters. Jarrah, blue gum and greenheart last much longer in English waters than in warm waters. Woods with a good record in one location may not do well in another, so that local experience should be checked.

Treatment of water: Electrolysis of the water around the pile to free chlorine has been proposed but experiments seemed to indicate that the chlorine was removed by water currents, and that *Teredo* merely ceased feeding while the concentration was high. Frequent repetition of treatment would be needed to kill the swarm of new larvae coming with each tide.

Reduction of salinity by barriers installed to keep salt water out of estuaries, rivers and portions of bays has been suggested, to create conditions under which the borers cannot live. This would generally have to be a community enterprise, and is a remedy beyond the reach of an individual owner. Fresh water was pumped into the sea at Hartlepool, England, in sufficient quantity to dilute the sea water and kill borers in a log storage area.

Toxic treatment of water is a possibility, using slowly soluble toxics near piles, by attaching tubes or cloths to the piles. There are a number of toxics which would kill both larvae and adult borers of both types in the immediate vicinity of the infested structure. It would be necessary to repeat the treatment every 2 to 4 weeks during the breeding seasons. But, the toxics would also kill other marine life there, as well as in other regions where washed by tides, currents and winds so that legal complications might ensue.

Alternate preservatives: Most of the other wood preservatives in use are salts that leach and are not suitable for submerged piles. Many arsenic, copper and other highly toxic salts in soluble and insoluble form have been used experimentally, but have failed to protect marine piles. Salts insoluble in water and soluble in the digestive juices of higher forms of life have been found not effective, possibly because the



American Wood Preservers Assn. photo

Fig. 6. Untreated pile in Playland Pier at Rye, N. Y., on Long Island sound, in "uninfested" waters. The 377-ft. long, 36-ft. wide pier was built in 1928. About one sixth of the piles were replaced by 1931, a third by 1934 and all by 1938. A teredo is shown on the paper, with a cut-off from a replacement creosoted pile below.

digestive apparatus of borers does not produce chemical substances to make the salts toxic. Pintsch gas tar affords considerable protection when painted or sprayed, but is reported definitely inferior to creosote.

Creosote applicator: Floating collars for applying a creosote coating have been extensively used to provide protection against marine borers in Australia, where attacks seem to be concentrated near the low water mark. The method was developed for preserving piles not too seriously damaged to carry the loads. It is especially suitable for wharf piles where attack is from the crustacean, and not teredine, borers, and where attack is mostly between tide marks. The collar is a round, hinged, galvanized iron casing supported on floats, with the top about 18 in. above the water line. The depth of the cylinder may be as much as 8 ft. In treating piles more than 4 ft. below low water, a fixed one-piece envelope of oiled fabric can be passed down into the water and clamped together as it enters. Any toxic, non-soluble liquid lighter than water can be poured into the small space between the cylinder and the pile, gradually displacing the water. The oil travels up and down the pile with the tide and collar. A 24 hour treatment has been found to kill all crustacean borers. The treatment is repeated annually for a few years. This method is apparently effective, of low cost, simple to use, permits inspection of the piles and does not add weight.

Electroplating: Copper plating, consisting of impregnating the wood with a copper sulphate solution by ionization, by means of wrapping a metal-graphite coated pile with copper wires set in slots and suspending the pile in an electrolyte of copper sulphate and sulphuric acid, was tried during the war. While good earlier service records were noted, it was reported that later service records have shown rapid failure.

It is possible that the new plastics industry will develop some method of providing an economical resistant coating.

Reprints of the four articles on *Finding and Fighting Marine Borers* are available at 25c. for the series; five or more sets at 20c. each.

A few reprints of a series of three articles by the same author on *Piles and Pile Foundations* still are available at 25c.; five or more copies (in any desired combination with the Marine Borer reprints) are 20c. each.

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Research projects

Marine borer research in the United States is based to a great extent on the investigations of the Marine Piling Committee of the National Research Council, and in the British Empire on the Reports of the Committee of the Institution of Civil Engineers. Testing grounds are also being operated in the tropics. The report of the San Francisco Bay Marine Piling Committee is a valuable treatise. In North Atlantic harbors investigations have been conducted by the New England Marine-Piling Investigation Committee. The work of William F. Clapp in his marine biological laboratory at Duxbury, Mass. has been invaluable in clarifying conditions, involving classification of species, life cycles, habits and environments of borers, with observations on test blocks and structures in various parts of the world. Many test boards are located under important wharves and provide insurance against unnoticed sudden damaging attacks. Further cooperation of owners of existing and proposed structures with researchers should result in mutual advantage.

Acknowledgments

Acknowledgments are made to the report of the San Francisco Bay Marine Piling Committee, the report of the Marine Borer Research Committee of New York Harbor, the report of the Marine Piling Committee of the National Research Council, the reports of the Sea-Action Committee of the Institution of Civil Engineers, various publications and comments by William F. Clapp, and publication of the U. S. and Canadian forest products laboratories, among other sources.

Thanks are due to Dr. Clapp, the University of California and the American Wood Preservers Assn. for a number of the photographs.

Houston Sludge Disposal Studies Favor Fertilizer Production

***Contents in Brief**—An analysis of eleven different methods for disposal of sludge at Houston, Texas, reveals that dewatering and drying of undigested, excess solids from activated-sludge processing is the most economical and practical method. Cost estimates are based on marketing the dried sludge for fertilizer in Texas and nearby states, which is expected to provide an annual revenue of $268,000.*

PRODUCTION of dried sludge for fertilizer is recommended as the most economical means for the final disposal of sewage solids at Houston, Texas, in a joint report submitted by Greeley & Hansen, consulting engineers of Chicago, and J. G. Turney, consulting engineer of Houston. The city council has approved the report and detailed plans and specifications are now being drawn.

Based on an analysis of various methods of sludge disposal, the consultants reached the conclusion that only two—lagooning and fertilizer processing—are entirely feasible and practical for conditions in Houston now and for twenty years hence. On the basis of actual net total annual cost, the fertilizer-production process is the most favorable, studies showing this to be $57,420 as against $100,550 for lagooning.

Other estimates, reflecting average values over the period 1950-70, indicate that the annual market-demand for Houston dried sludge to be used as fertilizer would be in excess of 21,900 tons. The average selling price, which is said to be conservative, is placed at $12.25 per ton.

Experience at Houston since 1936 with the sale of dried sludge (relatively small amounts, however) has shown that it commands a ready market at prices varying over the years from a low of $10.93 per ton in 1941 to a high of 17.25 last year.

Lagoon long used at Houston

Reason for the comprehensive report on sludge disposal was Houston's pressing need to reach a decision concerning new facilities to serve the existing North Side (18 mgd. sewage treatment plant) as well as the recently completed Simms Bayou (20 mgd.) activated-sludge works.

At the North Side plant, which was built in 1916, both primary and excess activated sludge has been disposed of in lagoons. However, since 1921, a certain amount of activated sludge has been dewatered and dried. Various types of equipment have been employed for this purpose over the years, the present installation consisting of four 700-sq. ft. disk filters and two rotary kiln dryers along with auxiliary equipment for processing sludge into fertilizer.

At the Simms Bayou plant, which has just gone into operation, temporary lagoons will be utilized for sludge disposal.

In their study of possible disposal procedures, the consultants based all computations on conditions estimated for the year 1970. Total population was placed at 776,810; quantity of sewage flow at 68 mgd. (average annual); and suspended solids in the excess activated sludge (on a dry basis) at 70.88 tons per 24 hours.

Investigation of costs

Eleven different methods of sludge disposal were investigated. These included dewatering, drying, incineration, lagooning and barging to sea, as well as combinations of these methods with separate consideration for handling raw and digested sludges. In Table I are tabulated the results of the cost analysis both for construction and on an annual basis.

Estimated net total annual costs in Table I are the sum of annual operating costs and debt service, less the revenue received from the sale of fertilizer, which is available only in projects designated 2R, 6R and 2D.

As an overall conclusion, it was decided that the digestion of sludge is not economical under Houston conditions. Said the consultants:

"Some revenue or saving in operating costs might be available from the sale or use of sludge gas, but little is to be gained by such sale or use. Assuming the value of sludge gas to be in direct proportion to its heat value as compared to natural gas, it would be worth only $0.06 per 1,000 cu. ft. Taking the amount of excess

TABLE I—SUMMARY OF TOTAL CONSTRUCTION AND ANNUAL OPERATING COSTS OF VARIOUS SLUDGE DISPOSAL METHODS APPLICABLE FOR CONDITION AT HOUSTON

Project	Estimated Total Construction Cost	Estimated Net Total Annual Cost
Raw Sludge		
1R—Dewatering and hauling sludge cake to disposal area	$1,237,000	$268,060
2R—Dewatering and drying	2,078,000	83,330
3R—Dewatering and incineration	2,158,000	367,120
4R—Lagooning	985,000	100,550
5R—Barging to Gulf	984,000	443,960
6R—Existing lagoons at North Side plant and dewatering and drying	1,394,000	57,420
Digested Sludge		
1D—Dewatering and hauling sludge cake to disposal area	$3,172,000	$355,830
2D—Dewatering and drying	3,869,000	295,300
3D—Dewatering and incineration	3,921,000	397,420
4D—Lagooning	2,906,000	227,240
5D—Barging to Gulf	2,620,000	249,030

gas available under 1960 conditions as representative of average conditions for a 20-yr. period, the value of the sludge gas would not amount to over $9,500 per year. Projects for sludge disposal, which include digestion, are relatively high in net total annual cost and are not recommended."

Basis of final decision

The projects that show the lowest total net annual costs under Houston conditions, said the consultants, include the one in which the sludge is disposed of by lagooning and the one in which the sludge is dewatered and dried and sold as a fertilizer. Accordingly, these two projects were investigated in considerable detail.

The project for sludge disposal by lagooning (project 4R) is based on discharging sludge into lagoons at the rate of 100 tons of dry, suspended solids per acre-ft. per year. At the site for sludge lagoons a sufficient area is proposed for dumping the more or less dry material removed from the lagoons every few years. Esimated cost of this project is $985,000 for construction, and $100,550 on an annual basis. No revenue is estimated from the sale or use of sludge in this project.

The project for sludge disposal by dewatering and drying and eventual sale as a fertilizer (project 6R) is based on the location of sludge dewatering and drying works at the North Side sewage treatment plant. From the investigation of still another project, which included sludge disposal facilities to provide capacity for the estimated quantities of sludge in 1970 along with standby units for the major items of equipment, it was concluded that a more favorable procedure in Houston is to continue the existing sludge lagoons at the North Side treatment plant in operation.

It is proposed to utilize these lagoons for the disposal of peak quantities of dry solids and for storage during periods when the dewatering or drying equipment is temporarily out of service. It is estimated that of the 71 tons of dry solids per 24 hr. in 1970, 10 tons will be disposed of in the lagoons. This arrangement permits a considerable reduction in the size and cost of the drying plant.

The estimated cost of this project is summarized as follows:

Item		*Amount*
Construction		$1,391,000
Annual Cost		
Operation	$261,020	
Debt Service	64,400	
Total		325,420
Revenue		268,000
Net Total		$57,420

In the foregoing estimated net total annual cost, an amount is included of $268,000 as revenue from the sale of the dried sludge. Careful investigation indicates that a ready market may be expected in areas reasonably accessible to Houston, including the Rio Grande Valley, areas of Georgia and Florida, as well as adjacent areas in Texas. As an average of the period ending in 1970, estimated quantities and costs are related to the year 1960 and, at this time, the estimated quantity of sludge to be sold during a year is 21,900 tons. An inquiry indicates that a market should be available for a larger quantity than the foregoing.

Selling price

The average selling price for the dried sludge under Houston conditions is estimated at $12.25 per ton. Based on past records and present conditions, this estimated unit price is considered to be reasonably conservative. There is no complete assurance, of course, that the sludge sales in the amount estimated will be realized, but so far as predictions can be made, the estimated total annual revenue is considered to be reasonable in amount.

The estimated net total annual cost of project 6 R ($57,420) is thus less than that of project 4R ($100,550).

In the opinion of the consultants, both of these projects are entirely feasible and practical from an engineering standpoint, and either will provide satisfactory sludge disposal. Inasmuch as project 6R provides a final disposal of the sludge at a

BASIC DATA EMPLOYED BY THE CONSULTANTS IN MAKING CONSTRUCTION-COST AND ANNUAL-COST ESTIMATES

Debt service was included at 4.62 percent of the total construction cost and is based on bonds at 2¼ percent interest for a 30-yr. term. Construction costs are related to an *Engineering News-Record* Construction Cost Index of 425 and include a contingent allowance of 15 percent.

Unit construction costs of some of the major items, which were used in comparing projects, are as follows:

Buildings
- Substructures, per cu. ft. $1.00
- Superstructures, per cu. ft. 0.80

Dewatering Equipment
- Per sq. ft. of vacuum filters 85.00

Drying Equipment
- Per lb. of water evap. per hr. ..... 10.00 to 12.00

Incineration Equipment
- Per lb. of water evap. per hr. ..... 12.00 to 14.00

Sludge Digestion Tanks
- Per cu. ft. capacity $0.85

Sludge Storage Tanks
- Per cu. ft. capacity 0.65

Sludge Elutriation Plant
- Per cu. ft. of elutriation tank capacity 3.75

The items making up annual operating costs are as follows:

Administration—In all projects except 2R, 6R, and 2D, one-third of the plant superintendent's annual salary of $4,800 plus clerical help is charged as administration costs for sludge disposal. In Projects 2R, 6R, and 2D, which contemplate a fertilizer manufacturing business, the salary of a manager at $4,800 per year and additional clerical help are added.

Fertilizer manufactured from raw sludge is estimated to produce a revenue of $12.25 per ton of product containing 10 percent moisture and nitrogen and phosphoric acid in the amounts of 4.5 percent and 2.5 percent, respectively. Fertilizer manufactured from digested sludge is estimated to produce a revenue of $6.40 per ton of product containing 10 percent moisture and nitrogen and phosphoric acid in the amounts of 2.25 percent and 2.0 percent respectively.

Labor—Includes all operators and laborers for operation of sludge disposal facilities. Annual salaries are estimated to range from $3,000 for operators to $2,250 for laborers.

Power—$0.006 per kwh.

Fuel—Natural gas (1,000 Btu. content per cu. ft.) for sludge drying and incineration at $0.10 per 1,000 cu. ft.

Chemicals—Cost of chemicals is based on the use of ferric chloride at $0.04 per lb.

Barge and Tug Rental—Barge rental at $500 per month and tug rental at $100 per day.

Maintenance, Repairs, and Supplies—For buildings, an amount of 1 percent of their estimated construction cost is included. For equipment, an amount of 4 percent of their installed cost is included.

After the projects had been considered, reports Mr. Greeley, it was recommended that the construction cost estimated in accordance with the foregoing units be further increased by 7.5 percent as a safety factor.

smaller net total annual cost than project 4R, its adoption is recommended based on this analysis. Under present construction and manufacturing conditions, the consultants believe it advisable to arrange for a possible expenditure of $1,500,000.

Although project 6R has a potential advantage of a lower cost of sludge disposal over a period of 20 years from 1950 to 1970 of perhaps $800,000, there are said to be some elements of risk and uncertainty involved in the processing and sale of the sludge that are not inherent in project 4R. The advantage results in the sale of fertilizer and the income therefore depends on marketing at a favorable price. The cost of processing includes considerable labor and cost for chemicals, repairs and other items.

In conclusion, the signers of the report, Messrs. Greeley and Turney, say:

"Our estimates have been conservatively made on the basis of experience at Houston and elsewhere, and after careful inquiry into the possibilities of marketing fertilizer, but future economic conditions can change the relationship between cost and revenue. If the city of Houston is prepared to enter the business of manufacturing and selling fertilizer, we believe this to be the most favorable method of sludge disposal."

Acknowledgments

The report, from which this digest was made, was furnished by the consulting engineers with the permission of J. M. Nagle, director of the department of public works, City of Houston, and William E. White, assistant city engineer.

Borers Undeterred by Domestic Sewage

A study of borer infested waters in Long Island Sound, made by the Wm. F. Clapp Laboratories of Duxbury, Mass. for the Port of New York Authority, indicates that borer activity is not appreciably affected by treated domestic sewage effluent. Conversely, there is reason to believe that industrial wastes do have a substantial effect on destructive marine organisms.

Primary purpose of the survey was to determine what effect "cleaning up" New York harbor might have on marine borer activity. The harbor has been relatively free from such attacks since 1875, presumably because of sewage pollution. The study was made in connection with a Port Authority proposal to take over piers owned by the City of New York. *ENR*, Feb. 26, p. 324.

Studies were made in December, 1947, on wood structures in Oyster Bay, Hempstead and Northport harbors, selected because (1) marine borers were known to be present; (2) untreated wharves existed at various distances and directions from the treated sewage outfalls; (3) the amounts and nature of the effluent were known.

The following is condensed from Mr. Clapp's report:

Data obtained certainly can substantiate the theory that sewage treating plant effluent, in the ordinary dilutions, has no noticeable effect on marine borers in adjacent waters. Any chlorine used in the treatment plant is dissipated immediately and has no influence on the destructive organisms.

The principal effect of sewage treatment, as it is carried out in the New York area, is removal of suspended solids and harmful bacteria. Chemically speaking, the treated effluent is very little different from the raw effluent. One factor that might be affected is dissolved oxygen. Removal of bacteria and the like from the sewage would tend to raise the amount of dissolved oxygen present. As the amount of sewage treated in the area has increased, there has been a slow but gradual increase in the dissolved oxygen content. It is expected that this value will continue to rise.

Dilution of the sewage effluent in the harbors studied is much more than in New York harbor proper, which approximates 1.5 percent. However, piles in the areas immediately adjacent to the outfalls were at least as heavily attacked as those definitely away from any possible sphere of influence. Records on file at the W. F. Clapp Laboratories confirm this finding. In an installation at Tacoma, Wash. an 8-in. sewage line serving 15,000 persons daily empties under a 2,880 ft. pier, one of the lines being 75 ft. from a wood test panel. Practically every test panel from this location has been riddled by marine borers within a month. There are also records of wood sewer outfalls having been destroyed by marine borers.

The evidence seems definitely to point to the fact that as far as sanitary wastes alone are concerned, if the dissolved oxygen content is high enough, there is no marked effect on marine borers by either treated or untreated effluent.

Industrial wastes important

There is no question but that industrial wastes are of much more importance. These waste waters pass into sewer lines and through treatment plants practically unaffected chemically. Some 90 percent of the industrial wastes pass into public sewers from small industries scattered throughout the city and are not chemically changed in the sanitary treating process. The remaining 10 percent comes from industrial plants where the trend is for gradual neutralization of acids and alkalies by the individual plants before the effluent leaves the site.

No radical changes in the situation are anticipated unless economic developments affect the number of active industries in the New York area. Clean-up programs will tend to increase in scope, but not particularly in method. With additional sewage removal the dissolved oxygen will tend to rise but even at the present time the values in many parts of the harbor are sufficiently high for borer activity, if other conditions were favorable.

In conclusion, Mr. Clapp wrote that the lack of severe marine borer activity in New York harbor is probably due to a combination of environmental factors, which are not completely known at the present time. In his opinion, present untreated piling in the harbor proper may be expected to have 20 to 30 years of additional service life if no unforeseen radical change in conditions occur. But for future construction in which it is advisable to use timber piles they should be treated to refusal with an accepted grade of creosote.

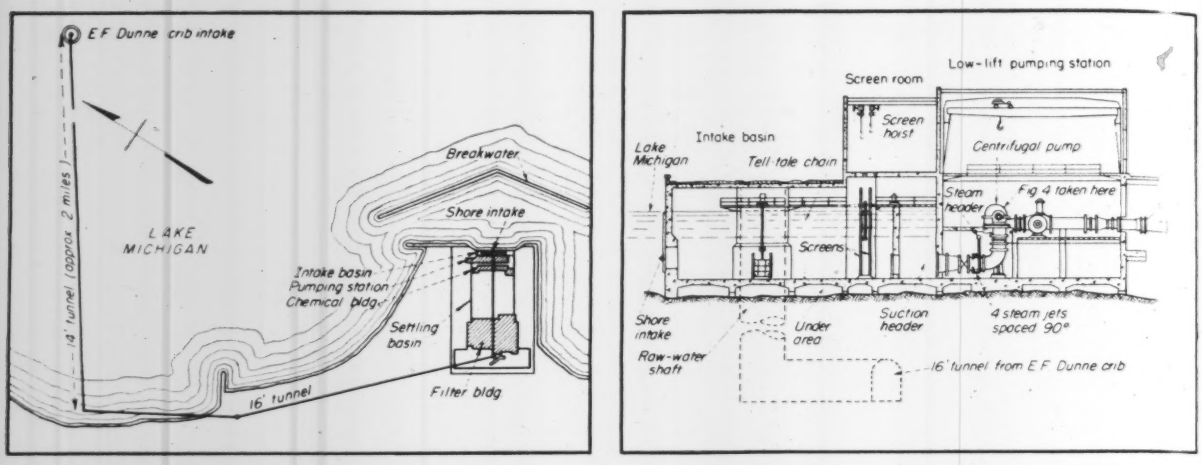

Fig. 1. Lake Michigan water is drawn either through the Dunne crib or the shore intake (left). To prevent frazil-ice formation in low-lift pumps, steam is shot into suctions through four one-inch corporation cocks spaced 90 deg. apart on the circumference of each pipe (right) to produce a rise in water temperature of about 0.1 deg. F.

Fighting Frazil Ice at a Waterworks

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Contents in Brief—Difficulties from frazil-ice formations occurred at Chicago's South District filtration plant during the first two winters of operation when Lake Michigan water was drawn through the shore intake. On numerous occasions low-lift-pumping capacity was seriously reduced by frazil-ice on impellers. To prevent such clogging, steam at 90-100 psi. is injected into pump suctions so that water temperature is raised about 0.1 deg. F. or just above the critical range of frazil-ice formation. In addition, ice on crib-intake ports is removed by discharging dynamite in front of the openings. On Jan. 29, 1948, an unusual ice plug in the intake shaft of the Wilson Ave. crib caused a shutdown of all except one pump in three stations. This stoppage was blasted out with dynamite.

FRAZIL-ICE formations on the impellers of low-lift pumps at Chicago's South District filtration plant threatened to shut off the raw-water supply from Lake Michigan on 36 separate occasions during the last two winters. Of the several remedies applied to insure uninterrupted supply of treated water the most satisfactory was found to be injection of steam into pump suctions to raise water temperature just above the critical point of frazil-ice formation.

Records show that frazil ice accumulated in the low-lift pumps 23 times from Dec. 23, 1945 to Feb. 28, 1946 for a total of 120 hr. During the following winter (Dec. 30 to Mar. 17) thirteen similar periods, totaling 147 hr., were experienced. The duration of these periods varied from 0.5 to 14.75 hr. in the first instance and from 2.0 to 34.0 hr. in the latter.

Characteristics of frazil ice

Differing from the needle-shaped formations reported by many observers, frazil ice on the impeller was composed of thin, transparent, perfectly round, flat crystals, shaped somewhat like fish scales. After initial adherence to submerged surfaces, crystals grew rapidly from $\frac{1}{8}$ in. to as large as 4 in. in diameter and $\frac{1}{32}$-in. thick. With irregular edges, the flat surface stood out perpendicularly from the metal to which a section of the edge was attached. Clusters of crystals tended to form into flower-like rosettes on submerged surfaces in the intake basin and accumulated on impellers in dense, opaque ice masses.

Precise measurements taken in the intake basin during frazil-ice occurrences revealed temperatures below 32.0 F., indicating supercooled water. For example, a water temperature of 31.893 deg. F. was observed on Feb. 15, 1946.

Analyses of meteorological data previous to and during each period indicated that frazil ice formed under widely varying conditions of wind direction and velocity and rising-and-falling air temperatures. The only consistent factor was that ice usually accumulated in the late-evening or early-morning hours and rarely lasted until noon.

During frazil-ice periods, water in the forebay (between shore intake

and breakwater) usually was covered in part with surface ice. On two occasions this condition developed when the forebay was iced over completely. Frazil ice in water drifting past the shore intake, even with the forebay frozen over, was another signal of impending clogging. With northerly winds, frazil ice appeared first in the north ports of the shore intake. Pumps in the north end of the station iced up while the south pumps remained unclogged. Likewise with southerly winds, pumps on the south side of the station accumulated ice on the impellers while those on the north side continued to operate at full capacity.

Raw water taken through shore intake

During the first winter of filter-plant operation (1945-46), all water was drawn through the shore intake (Fig. 1). The gates at Dunne crib (an offshore lake intake), were left open so that either a part or the entire demand could be supplied through the lake intake in event of a filtration-plant shut down. With this precaution, an uninterrupted supply of water was insured but every effort was made to avoid use of untreated water brought through the crib.

To be forewarned of icing troubles, a chain in the intake basins was suspended in the water during the winter season (Fig. 1). If ice adhered to this tell-tale chain (Fig. 2), loss of raw-water capacity due to ice clogging was expected.

Frazil-ice on the chain was observed for the first time at 3:40 A.M., Dec. 23, 1945. About the same time low-lift pumpage dropped off rapidly and frazil ice was found on intake screens (Fig. 1) which were raised immediately. Since the intake-basin and suction-header water level remained normal, it was assumed that ice was forming in the pump suctions (later this proved to be incorrect).

Attempts to restore pumping capacity

To restore pumping capacity, various expedients were tried. The following methods were found effective:

1. Closing discharge valve and allowing pump to run for about 5 min., with no discharge. The churning action raised the temperature of water in the pump so that ice melted and broke loose.

2. Cutting electric power to the pump motors without closing discharge valves. When this was done, flow through pump was reversed and ice clusters were flushed back into the suction header (Fig. 1). The shape of these masses indicated that clogging occurred within the pump and not in the suction.

Fig. 2. Frazil-ice accumulation on a tell-tale chain hung into intake-basin water predicts ice-clogging troubles.

3. Putting the pump out-of-service for 15 to 30 min. to melt accumulated ice by room temperature. The pumps are housed in a closed well.

4. Pumping seepage water from beneath the filtration plant into the south intake basin. A large basin under the plant collects seepage and from time to time it is dewatered. When this water with temperature about 37 deg. F. was pumped at a rate of 5 mgd., it was discovered the two adjacent pumps usually did not clog with ice. Calculations showed that the temperature rise necessary to prevent ice formation was only about 0.1 deg. and that 5 mg. of water at 37 deg. F. would heat 200 mg. of 32 deg. F water by 0.12 degrees. This method of keeping two pumps in service with a combined capacity of 200 mgd. became standard practice during ice troubles.

Compressed air discharged into the water through a perforated-pipe header just ahead of pump suctions did not inhibit formation of frazil ice on pump impellers. However, compressed air discharged in front of a sluice gate was effective in removing frazil ice from the opening.

After several ice-clogging occurrences and examination of back-flushed pieces of ice, it was decided to determine exactly where ice collected. Removal of a pump-casing manhole disclosed that frazil ice formed

Fig. 3. Frazil ice on entrance to impellers of low-lift pumps reduced capacity.

around the water entrance to the impellers (Fig. 3).

Steam injection prevented clogging

As studies showed that frazil ice could be prevented by raising water temperature about 0.1 deg. F., a pipe system for injection of steam into pump suctions was installed in the fall of 1946 (Fig. 1).

This piping consists of a 4-in. steam line from the boiler to pump room; 1½- and 1¼-in. headers to large and small pumps, respectively; one-inch connectors from headers to corporation cocks; and four one-inch corporation cocks spaced 90 deg. on the circumference of each suction pipe.

Steam injection at 90-100 psi. through three cocks into the suctions of large pumps produced a rise in water temperature of 0.130 deg. F. Steam discharged through one nozzle of small-pump suctions caused a similar rise of 0.105 deg. F.

Injection of steam into pump suctions successfully precluded frazil-ice clogging during the winter of 1946-47. Although frazil-ice prevailed thirteen times in intake water from Dec. 30, 1946 to Mar. 17, 1947, no interference with pumping capacity was experienced.

Shore intake ports clog

On one occasion during a severe frazil-ice period (Feb. 6, 1947), ice formed in shore-intake ports and threatened to shut off the raw-water supply. The water level dropped several feet in the intake basins. This occurred at a time when the Dunne-crib tunnel was out of service, and the only means for obtaining water was through the shore intake.

As immediate correction was required, part of the settled-water supply was used in an effort to clear the ports. Pumps were cut off while valves were left open. This action permitted settled water to flow backward into the intake basins. After the water surface had been raised several inches above the lake level, ice on the intake ports broke loose.

Following resumption of normal operation, it was found that ice had been completely removed from gate openings. During two winters of use, shore-intake ports were plugged with ice only on this occasion.

Water now taken from Dunne Crib

Upon completion of tunnel connections to the Dunne-crib intakes, the plant supply was obtained from this source on April 4, 1947. Past experience indicates that fewer ice troubles develop when water is taken through the crib. Clogging of low-lift pumps will not result as the water is warmed slightly in its passage through about three miles of tunnel.

No clogging occurred during the past winter as all or most of the water is taken through the crib intake.

Attendants at the Dunne crib maintain port openings free of ice. Screens are raised before water temperature drops to 32 deg. F. Frazil ice on the ports is cleared by exploding ½ to 1 sticks of dynamite in the water opposite the openings. Taped together, the dynamite and cap are lowered by a rope or pole and discharged electrically.

Recent related experiences

Serious ice clogging at the Dunne and Wilson Ave. cribs developed during the period Jan. 26-30, 1948. At the Dunne crib, frazil-ice was observed late in the afternoon of Jan. 26 and dynamite blasts in front of the ports were set off frequently to maintain flow. In the early morning of Jan. 27 severe clogging occurred and a number of blasts were made. At 1:00 A.M. the intake-basin level at the filtration plant dropped to —10.8 ft., the point at which there is danger of losing low-lift pump suction.

Heavier charges were then fired which resulted in improved inflow for a short period. One-third of a stick of dynamite was used for most of the blasts but in this case a whole stick was used for two firings.

Clogging was so great at 10:00 A.M. that sufficient water could not be obtained through the Dunne crib. The shore intake was then turned on. No further difficulty was experienced at this crib after Jan. 28 although the tell-tale chain showed some frazil-ice on the following day.

Anchor ice at Wilson Ave. crib

Anchor-ice (submerged formations of needle-like crystals) in the 12-ft. intake shaft of the Wilson Ave. crib early on Jan. 29 cut off one of the city's four water supply tunnels. Reduced pressure prevailed for several hours on the distribution system which serves nearly 1,000,000 people.

Failure of supply was first noted at 6:15 A.M. by the Mayfair pumping station, farthest inland of three stations that are fed by the Wilson Ave. crib. As the pumps were unable to function, main pressure dropped to zero at a few points and to 5-15 psi., over most of the area. (Normal pressure is 40 to 50 psi.) This low pressure was maintained by feeding from the central and south districts.

No indication of water-supply failure was apparent at the crib. Ports were open and water level was normal. It was concluded, therefore, that the intake shaft was plugged.

DESCRIPTION AND STATISTICS OF INTAKE AND APPURTENANCES

Dunne Crib Intake: Two miles offshore in 32 ft. of water; Eight ports, 7x7 ft., 25 ft. below lake level; two 14-ft. shafts descending 139 ft. to the tunnel and equipped at the top with ½-in. mesh, removable screens; connected to filtration plant by 11,000 ft. of 14-ft. and 6,200 ft. of 16-ft. tunnel; tunnel terminates in three 12-ft. shafts—one in each basin and a third located to feed either basin; each shaft controlled by six 5x5-ft. sluice gates.

Shore Intake: Two basins, each 190 ft. long and 60 ft. wide; Floor 24 ft. below lake level; Seventeen 6x8-ft. intake ports for each basin; Total port area 1,632 sq.ft.; Average water velocity at 300 mgd., 0.28 fps., and at 400 mgd., 0.38 fps. Thirty-three 7.25x14 ft. screens with one-inch mesh, and hoists for raising and lowering.

Suction Header; Low-lift pump suctions draw from a header into which water from either or both intake basins is fed through eight 8x8-ft. sluice gates.

Low-lift Pumps: Four 120 mgd. and four 60 mgd. motor-driven, centrifugal units; Pump suction diameters—54-in. for the former and 42 in. for the latter; Operating Head—20 to 25 ft.

Light blasting with ¼-lb. of 60 percent dynamite successfully opened the shaft. A single shot in the shaft restored normal water flow after five shots in the crib well, surrounding the shaft walls, produced no effect. As additional insurance, seven more shots were discharged in the shaft. Pressures gradually increased to normal during the next six hours.

Severe shortage created

Reduction of supply during this stoppage was particularly severe in the outlying districts of the distributing system. As some of the mains were emptied, the Chicago Board of Health recommended boiled drinking water for all residents in the affected area.

As a result of experiences at the filtration plant, it has been found that (1) frazil-ice accumulation on centrifugal-pump impellers can be prevented by the injection of steam at 90-100 psi. into pump suctions to raise water temperature about 0.1 deg. F. or just above the range of frazil-ice formation; (2) compressed air discharged in front of the opening of one gate removed frazil ice; and (3) ice on crib-intake ports can best be removed by electrically exploding ¼ to ½ of a stick of dynamite in the water opposite the openings.

The South District filtration plant is operated by the water purification division of Chicago's Bureau of Engineering which is administered by W. W. DeBarard, city engineer.

Arithmetical Shorthand Facilitates Computations

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For making arithmetical computations involving numbers with long strings of zeros before or after the decimal point, and for arithmetical work in general, much mental strain and waste of time can be avoided by a simple system of arithmetical shorthand employing what may be called "the superscript notation." The nature of this system can be understood from the following illustrations:

Ordinary notation:	7.62	87,500	0.0000261
Notation using powers of 10:	$7.62(10^{0})$	$8.75(10^{4})$	$2.61(10^{-5})$
Superscript notations:	$7^{0}62$	$8^{4}75$	$2^{-5}61$

It is seen that any number, when written in the superscript notation, includes a "base" which gives the order of the digits, and a "superscript" which indicates where the decimal point would be located in the ordinary notation. For example, in the above illustration, the superscript 4 in the number $8^{4}75$ indicates that the decimal point would be four places to the right. The symbol group $8^{4}75$ may be read orally as "eight soup four seven five". It is noted that the superscript is the same as the exponent of 10 in the notation using powers of 10.

Superscripts may be printed with the same type that is used for exponents. The two can be distinguished by the fact that an exponent occurs only at the end of a number while a superscript occurs only between the digits of a number. In computation by slide rule it is convenient to write the superscript between the first and second digits. This minimizes the mental effort required to determine how many digits in the answer lie before the superscript.

Combining superscripts

The following rules for combining superscripts in numerical operations are easily deduced from the corresponding operations in the notation using powers of 10, but the computer will find it desirable to memorize the rules directly. The bases are combined by the ordinary laws of arithmetic, with the decimal point taken directly under the superscript.

Multiplication: The superscript of the product is the algebraic sum of the superscripts of the factors.

Example:

$$600\,(700) \quad 6^{2}0\,(7^{2}0) = 42^{2}0 = 4{,}200{,}000.$$

Division: The superscript of the quotient is the superscript of the dividend minus that of the divisor.

Example:

$$\frac{0.000072}{6000} = \frac{7^{-5}2}{6^{3}0} = 1^{-8}2 = 0.000000012.$$

Powers: The superscript of the power of a number is the exponent times the superscript of the number.

Example:

$$5{,}000^{2} = 5^{3}0^{2} = 25^{6}0 = 25{,}000{,}000.$$

Roots: A root of a number is regarded as a power to a fractional exponent. The superscript of the number should be placed so that the superscript of the root is not fractional.

Example:

$$\sqrt[3]{0.000064} = 64^{-6}0^{1/3} = 4^{-2}0 = 0.04.$$

Addition and Subtraction: Reduce all terms to the same superscript before combining.

Example:

$$0.00037 + 0.2172 = 3^{-4}7 + 217^{-4}2 = 220^{-4}9 = 0.02209.$$

The following example illustrates a typical computation in the superscript notation, the bases being combined by slide rule:

$$\frac{76500\,(0.1232)^{1/2}\,0.00000871^{2}}{240\,(0.00206)^{3}} =$$

$$\frac{7^{4}65\,(12^{-2}32)^{1/2}\,8^{-6}71^{2}}{2^{2}4\,(2^{-3}06)^{3}} =$$

$$\frac{7^{4}65\,(3^{-1}51)\,7^{-11}58}{2^{2}4\,(8^{-9}74)} = 9^{-1}70 = 0.970.$$

The outstanding advantage of the superscript notation, as compared to the ordinary notation or that using powers of 10, is its conciseness. The actual number of symbols or marks to be written on the paper, or identified by the eye, is much smaller than either of the other notations. This simplification contributes greatly toward clearness, speed and convenience in arithmetical work.

The engineer or scientist who adds this tool to his professional kit is quite likely to find that it saves headaches, time, paper, pencil lead and unprintable language. If generally adopted by technical men, it would save much space on printed pages.

Fig. 1. Utilization of cantilever construction is outstanding in the new concrete west stands at Georgia Tech.

Stadium Press Box on Stilts

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Contents in Brief—A unique feature of the concrete stands at Georgia School of Technology's Grant Field in Atlanta, Ga., built to replace an old section of the football stadium, is the press and radio box. This section, located above the seating area, is cantilevered from a single line of columns, and its roof, similarly constructed, serves as a photographers run.

UNOBSTRUCTED vision and economical utilization of space was achieved in the construction of concrete stands in the Georgia School of Technology football stadium by elevating the press and radio section on a single row of columns above the seating section. These columns act as vertical cantilevers supporting the horizontally cantilevered press and radio section and the roof, which is used as a photographers run.

Replacing the first permanent portion of the stands to be built at Grant Field in Atlanta, Ga., the new 450-ft. long structure seats 14,551—a net increase of 8,669—and completes the horseshoe-shaped football stadium. Demolition of the old stands was begun in January, 1947, and a close schedule was rigidly followed by the contractor to have the project completed in time for the first game in September.

Concrete was laboratory-designed and controlled for 3,000-psi. strength using a blend of portland and slag cements. It was mixed in transit and placed from buckets by a crawler crane. Reinforcing steel was composed of deformed bars with a design stress of 20,000 psi.

Seating sections and the photographers run were designed for a live load of 100 psf.; aisle, walkways and ramps for 150 psf. The wind load was taken as 40 psf. on the press and radio section and 50 psf. on the light standards.

The lights are 174 ft. from the side lines, rising 46 ft. 6 in. above the photographers' run and 122 ft. above the playing field. Rounded on the field side and flat on the corridor side for a ladder run, the light standards are 24x60 in. up to the photographers' run, 24x48 in. above, and support twenty-five 1,500-watt floodlights.

Slab thickness varies

For better visibility from the main seating deck, riser heights were increased in the upper half of the stands. The tangent section contains

29 risers at 10 3/16 in., 1 riser at 1 ft. 7½ in. and 21 risers at 1 ft. 4 in. Runs are 2 ft. 3 in., except for the lower horizontal aisle, which has a 5-ft. run. This aisle connects the vomitories, or entrances piercing the bank of seats (Fig. 1). Treads in the main seating deck are 3 in. thick, and in the lower horizontal aisle and end ramp, the slab is 4 in. thick.

The slab in the press and radio section is 4½ in. thick on the field side and 5 in. thick on the corridor side. Providing 136 seats for the press and six radio sections, the box is cantilevered from both sides of 24x40-in. concrete columns. Thus, columns do not interfere with lines of sight of observers either in the main deck or press area.

Above the press and radio section and similarly cantilevered from the columns is the photographers run, which allows complete end zone to end zone coverage. The slab is 5½ in. thick on the field side, 4-in. thick on the corridor side. The upper horizontal aisle, which has a 5-in. slab, is also cantilevered from the press-box columns, but at a lower level (Fig. 2).

In the main seating deck, girders are 18x24 in. Spaced 15 ft. 4 in. apart, they span about 18 ft. Columns are 18x18 in. and are supported on spread footings proportioned to give uniform bearing under dead load to obtain even settlement. Maximum soil pressure under the footing having the highest ratio of live to dead load was limited to 4,000 psf., based on experience with buildings previously erected in this area.

Location of joints

Footings for the portion of the older stands adjacent to the new section are on piles. To stand well away from these old footings, columns in the first two lines of the new section are supported on beams that bear on common footings about midway between the two rows. Dead loads are balanced, and pedestals are so placed as to give even bearing under the footings from these loads. The seating section is cantilevered from the last line of girders to the old section, terminating in an expansion joint at the line of intersection.

Expansion joints are also used to divide the west stands into seven sections and to separate these from the five identical vomitories and the exit ramp at the south end of the tangent section. This arrangement allowed a natural division of the work for forming and pours. With construction joints dividing the seating and concourse sections into three parts and the press-box section into two, a total of five main pours was required for each portion between expansion joints. Columns, however, were cast in advance of these divisions. The similarity of the construction of most of the work in the seating and press sections allowed almost complete re-use of form work between adjacent subdivisions.

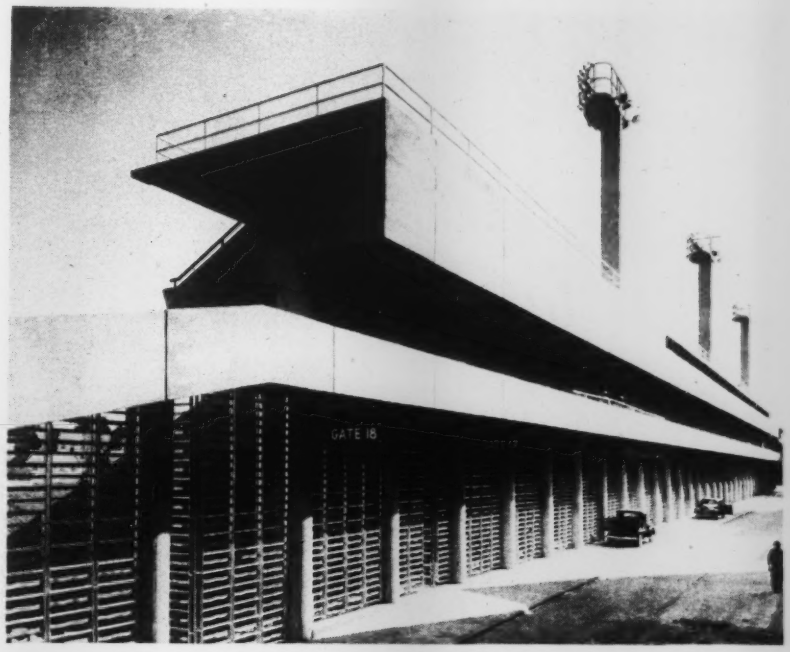


Fig. 2. Expansion joints in the cantilevered upper horizontal aisle and in the press and radio section above are located midway between girders.

In the main seating section, expansion joints are located at one side of the vertical aisles that are on the center line of the vomitories. Seating sections are cantilevered from the main girders to meet at these joints. In the horizontal aisle at the top of the main seating section, in the press and radio section, and in the photographers' run, expansion joints are located midway between the girders (Fig. 2). This places the joints in the rear of these portions in the same relative location as the control joints that are midway between the girders in all other bays.

The vomitories are supported independently of the main seating section. These are in effect bridges that lead into the lower horizontal aisle and were constructed in advance of the upper portion of the main seating section. The floor was cast first, and the side and cross-over walls poured in a separate operation, using only one set of forms for the five vomitories. These forms were stripped in large sections and shifted by a crane traveling along the street.

Ramps that are a continuation of the upper horizontal aisle are located at each end of the new stands and afford a means of access in addition to the vomitories. These ramps are cantilevered from either side of posts in the line of the press-box columns (Fig. 2). Provision has been made for the later addition of two bridges connecting the upper horizontal aisle and the school campus.

Planning of the project was undertaken for the Georgia Tech Athletic Association by Bush-Brown & Gailey, architects, P. M. Heffernan and R. L. Aeck, associates—all of whom are members of the Georgia Tech School of Architecture faculty—and construction by the J. A. Jones Construction Co. of Charlotte, N. C. Structural design was performed by the author, at that time associate professor of architectural engineering at Georgia Tech.

Fig. 1. Much of the new causeway connecting the Miami area (foreground) and Key Biscayne is exposed to high waves.

A Causeway Built to Withstand Hurricanes

Contents in Brief—In constructing a 4-mile dual-lane causeway across Biscayne Bay at Miami, a design offering high protection against hurricanes was necessary. The three long bridges required were supported on piles and built as simple steel-beam spans with the deck of composite construction and the parapets of a special curved design. Construction of the deck was expedited by use of steel forms handled by special trolleys. In building the long sand embankments connecting the bridges, the side slopes were made extremely flat and precast sheetpile bulkheads were used to protect the fills adjacent to the bridges.

A $6,000,000 CAUSEWAY designed to withstand heavy wave action and built to have a long life with minimum maintenance has been constructed to connect the mainland with Key Biscayne at Miami, Fla. The new facilities are planned to give much better service than the several causeways built in the past at Miami. Construction procedures developed on the new causeway offer useful ideas for other projects.

Known as the Rickenbacker Causeway, the project extends from southern Miami to Virginia Key and then onward to Key Biscayne (Fig. 1). It has a length of more than 20,000 ft. Over one-fourth of this distance is crossed by three bridges, one being 3,457 ft. long, another 2,090 ft., while the third is 662 ft. Remainder of the crossing is on three earth embankments or sand islands, one being nearly two miles long.

All the bridges, which are designed for an H-20 loading, provide a 44-ft. roadway with opposing traffic separated by a 15-in. median strip with scored reflecting curbs. An 18-in. safety walk is provided at each side. Across the embankments two 22-ft. roadways separated by a 36-ft. parkway and flanked by 15-ft. wide shoulders were built.

Because the causeway will be exposed to extensive wave action and high winds during hurricanes, a sturdy design had to be prepared. At the same time, in view of the great length of the project, the design had to permit economical construction and require minimum maintenance.

Wide embankments used

On construction of the sand islands, which have been completed for some time, the fills were built with a top width of 110 ft. and with the elevation of the roadway 7.5 ft. above mean sea level. To minimize erosion of the fill during strong wave action, 16 to 1 side slopes were used.

These islands were constructed as hydraulic fills with clean sand obtained a few thousand feet from the project, a total of 3,200,000 cu. yd. being required. The roadway pavement on the fills consists of a 12-in. compacted thickness of limerock so common to the Miami area and bituminous surface treatment. The shoulders are of similar construction but with the base only 6 in. thick.

Where the embankments join the bridges special precautions had to be

used to assure adequate protection of the fill against wave action. At these points the fills are confined by precast sheetpile bulkheads extending 6 ft. above mean low water.

Concrete piling was selected for the bulkhead construction because it was considered most resistant to heavy scour in a salt water exposure. The piling was precast at a central yard near the project. Most of the piles were from 10 to 19 in. thick and 2 ft. wide. They were all heavily reinforced to take the bending loads, and dowels were provided to form a strong tie to the continuous 18x24-in. cap added at the top of the bulkhead. Penetration of the piles, which varied from 16 to 28 ft. in length, was about 12 ft. for the longer members. They were driven with a double-acting 10,000-lb. hammer with a 5,000-lb. ram mounted in swinging leads handled by a crawler crane.

Piles for opposite sides of the bulkheads were tied together with 1-in. dia. steel rods on a spacing of from 6 to 8 ft. With the longer sheetpiling, the ties were attached to an outside precast concrete wale located at about mean low water, and for shorter piles the ties were anchored in the cap of the piling. The rods were protected with coal tar enamel.

Between the top of the bulkhead and the level of the roadway the side slopes of the embankment were made 1 to $1\frac{3}{4}$ and this surface was protected with a 6-in. thick pavement. The latter slab was reinforced with a layer of 4 x 4-in. mesh made of No. 4 wire.

Fig. 2. Driving of the steel shell piles for the bridges was expedited by use of telescoping struts between the leads and scow, which permitted the top of the leads to be moved sideways, as well as forward and backward.

Simple spans are used

In view of the great length of the bridges, detailed studies to determine the most economical design were required. These studies resulted in the selection of simple steel-beam spans supported on open rigid-frame, reinforced-concrete bents resting on piles. The economical span length was found to be 51 ft. and a total of 119 simple spans were built, which permitted production line methods and thus a cost saving.

At the location of the bridges the water depth varies from a few feet to about 20 ft. Soil studies showed up to 10 ft. of liquid silt overlying sand and broken and stratified limestone. In view of this condition, pile foundations for the bridges were specified. Use of timber piles was considered, as were pre-cast concrete piles, but the final plans provided for either lagged H-piles or for fluted steel shells filled with concrete. When bids were received, the latter type proved more economical.

The two footings for the typical foundation bent are spaced 29 ft. 6 in. center to center and each is supported on five 18-in. dia. piles each designed to carry about 42 tons. The five piles for a given footing were arranged with four piles in a square and the fifth a plumb pile at the center, all the corner piles being sloped away from the center on a batter of 1 to 8.

About half of the pile shells, which were of 7-gage material and averaged about 42 ft. in length, were put down by a combination of jetting and driving. But for many of the foundations a hard layer of rock about 2 ft. thick was encountered at approximately El. —15 and it proved difficult to drive the shells through this strata without serious damage. At these locations a few sticks of dynamite placed in a steel pipe were jetted down to the rock strata and detonated. It was then possible to drive the pile without jetting. A single charge of from 5 to 15 sticks each weighing $\frac{1}{2}$ lb. was sufficient to break up the rock for all five piles of a given footing.

Special support for leads

A steam-powered floating rig handled the hammer. The leads were mounted in a manner to allow the top of the leads to be moved back and forth as well as sidewise, which permitted a five-pile cluster to be driven with only a slight shifting of the rig (Fig. 2). Soon after a cluster had been driven, all-welded reinforcing cages made up of eight $\frac{3}{4}$-in. dia. longitudinal bars extending well up into the pile cap were inserted in the shells and the shells were filled with concrete designed for a minimum compressive strength of 3,000 psi. at

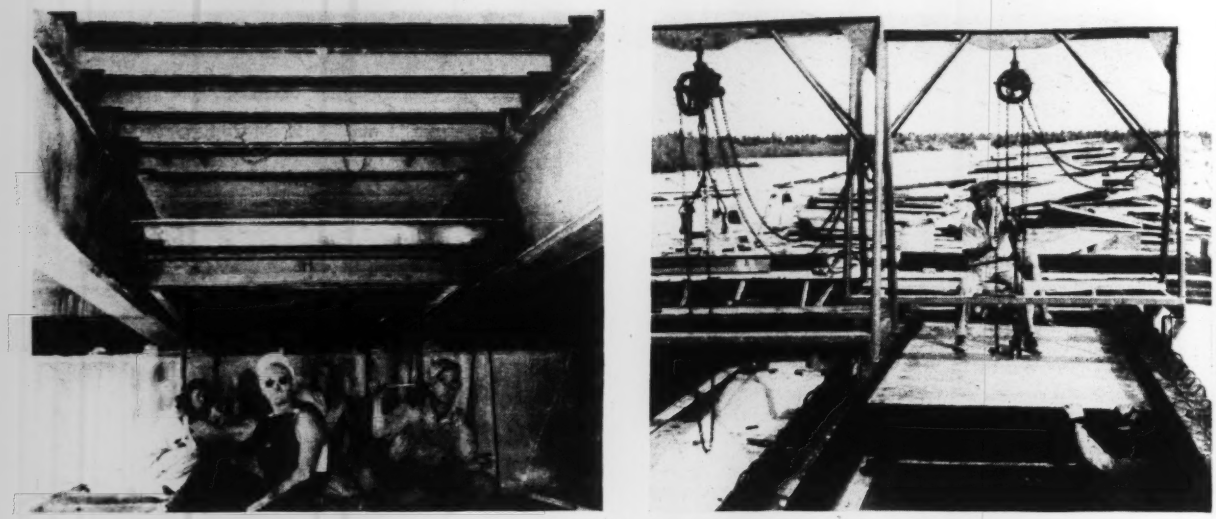


Fig. 3. The all-welded steel form panels employed on construction of the deck slab were quickly lowered onto small trolleys operating on the lower flange of the beams for transfer to the next span (left photo). In the new location the panels were raised into place with a trolley operating on top (right photo).

28 days. It was produced by a ½-cu. yd. mixer mounted on a scow of sufficient size that permitted all materials to be batched and mixed at the site.

All the pile caps were made 8 ft. square and 4 ft. thick. Construction of the caps, which extended 18 in. below mean low water, was expedited by hanging the bottom of the box form for the cap from the steel piles, the forms being handled by a small floating crane. Once the walls of the box had been set in place and braced with timber shoring to the piles, a 1-ft. thick tremie seal was added. This permitted all remaining operations in constructing the cap to be done in the dry.

Deck of composite design

Design of the deck is distinguished by the use of composite construction that called for spiral reinforcing rods welded to the steel beams. Studies showed that a conventional deck for all three bridges would require 7,400,000 lb. of steel and the composite design 5,600,000 lb. This saving was considered especially important, since work was begun at the start of the war program. Design of the deck is also distinguished by the use of a curved parapet of simple lines, which adds appreciably to the appearance of the bridges.

The deck is supported on eight 27-in. 91-lb. wide-flange beams. An 8x⅝-in. plate was welded to the bottom flange of all beams for the middle 32 ft. In addition, an 8x5/16-in. plate 20 ft. long was welded to the top flange of exterior beams. The spiral reinforcing welded to the top flange extends 6 in. above the flange. Both this reinforcing and the stiffening plates, which increased the economy of the composite design, were welded to the beams before they were shipped from the fabricating plant. The only field welding was the limited amount required in assembling the diaphragms between the beams. Erection of the beams was accomplished with the aid of a 20-ton floating derrick.

Construction of the deck was expedited by the use of sturdy all-welded steel forms built specially for the job. For the first several spans plywood forms were utilized for the lower surface of the deck. However, these were soon replaced with steel panels 12 ft. 6 in. long by 5 ft. 7 in. wide and supported by turnbuckle jacks on the lower flange of the beams (Fig. 3). The panels consisted of ⅛-in. checkered plate stiffened with channels welded along all four edges plus intermediate transverse channels at a frequent spacing.

Fig. 4. A longitudinal screed 53 ft. long handled by eight men speeded up the placing of the concrete, as did the special platforms for the buggies. The men behind the screed are standing on one of the platforms.

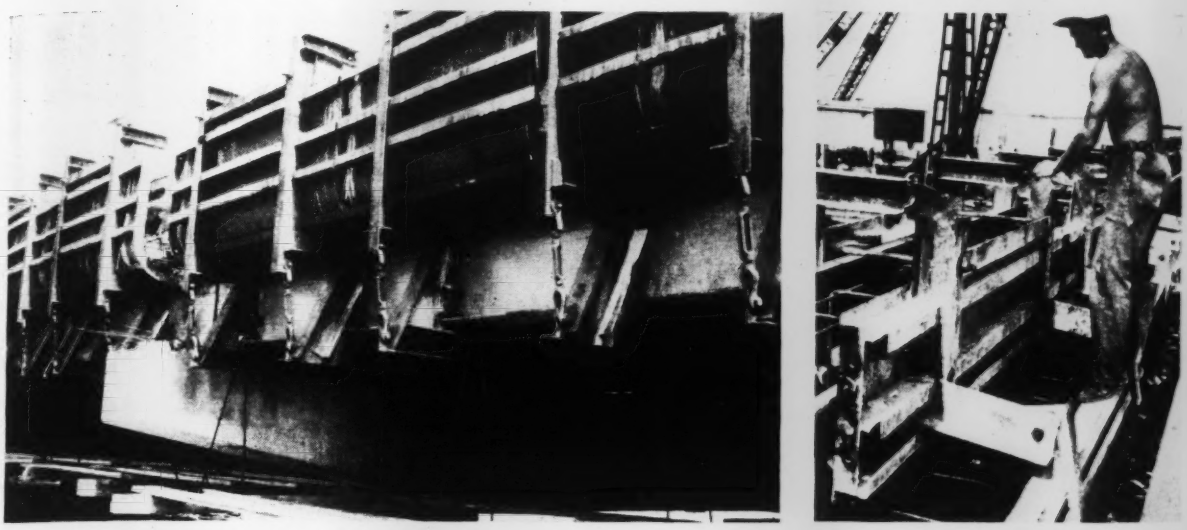


Fig. 5. All-welded forms for the exterior face of the parapet were supported on short channels carried on the lower flange of the exterior beams (left photo), and those for the interior face and sidewalk were suspended from the outer forms (right photo). Assembly of the forms was expedited by use of scaffolding hung from washers welded to the beam flanges.

Transfer of the panels ahead from one span to another and their reassembly was quickly accomplished by two special trolleys of all-welded construction. One trolley operated on the lower flange of the beams. It was equipped with steel wheels sufficiently small that they could clear the turnbuckle jacks supporting the panels and allow the trolley to travel across a foundation bent into the next span. This trolley was equipped at each corner with a large-diameter threaded bolt that could be extended to support the panel as the turnbuckle jacks were slacked off. The second trolley operated on the upper flange of the beams, and it was equipped with a chain hoist that permitted the panel to be raised quickly (Fig. 3).

Shifting and assembly of the forms was further speeded up by a scaffolding suspended from large washers welded to the lower flange of the beams (Fig. 5). These washers will be left permanently in place, since they are expected to prove of great value in assembling a scaffolding when the superstructure steel must be repainted.

Concrete for the deck was manufactured by a 27E single-drum paver mounted on a single barge. The paver discharged into a 1-yd. bucket handled by a crane dumping into a 1-yd. hopper located on the deck of the bridge and the concrete was delivered to the forms by rubber-tired buggies operating over special portable platforms made up in 5x8-ft. sections. Each section consisted of four 2-in. dia. steel posts about 10 in. long joined by a 3x3-in. angle iron to which was bolted 2x8-in. timbers.

General practice was to pave two spans of the deck each day concrete was placed. A concrete with a minimum compressive strength of 3,000 psi at 28 days was specified. Finishing of the deck was expedited by use of an all-welded longitudinal screed 53 ft. long and handled by eight men (Fig. 4). All concrete was vibrated.

Parapet forms

Construction of the curbs and parapets followed the placing of the roadway concrete by several days. Forms for this portion of the deck were made up mostly in 8-ft. sections and they were of special sturdy all-welded steel construction (Fig. 5). Each section of the outer forms for the parapet was supported on two steel channels with their outer ends clamped to the lower flange of the exterior beam. Turnbuckles between these channels and the upper parts of the forms permitted both accurate adjustment and easy removal of the forms.

The form for the inner face of the parapet and the curve was suspended from the top of the outer forms. Position of this form was adjusted by means of threaded ties between the inner and outer forms. Assembly and removal of the forms was expedited by use of a truck equipped with an adjustable boom and hand hoist that permitted two men to handle the sections.

Above the concrete parapet a steel railing of all-steel design was used. It consists of two 8x$\frac{3}{4}$-in. plates supported on about 6-ft. centers by 4-in. dia. pipe set in holes in the parapet. At the railing support at the center of the span the pipe was fixed in place by filling the space around it with sand-cement mortar. At all other supports the holes were sealed with a bituminous joint filler, which will allow the rail to expand and contract without misalignment.

Rickenbacker Causeway, which is named for Eddie Rickenbacker, president of Eastern Airlines, was built by Dade County, for which E. M. Rader is county engineer. J. E. Greiner Co., consulting engineers of Baltimore, Md., prepared all plans and supervised construction. R. A. Gilmore was project engineer for this firm, and E. J. White, resident engineer.

Arundel Corp., Baltimore, built the embankments and bulkheads, and the Reed Construction Corp., Miami Beach, Fla., the bascule span. The fixed-beam bridges and the toll house were built by E. H. Latham, West Palm Beach, Fla. Paving and utility construction on the embankments was done by W. T. Price Dredging Corp., Miami. The steel forms for the concrete work were leased by Dade County from Welded Steel Shapes, Inc., Coatesville, Pa.

Asphalt Plant Operating Costs

Ladis H. Csanyi
Consulting Engineer, New York

Contents in Brief—Operating costs in the new asphalt plant for the Borough of Manhattan, New York, where electric heating is used extensively, are given, together with some comparative figures for plants using steam heat. Also discussed are some of the advantages of electric heating for such plants.

DURING the first year of operation of the Municipal Asphalt Plant of the Borough of Manhattan that was described in *ENR* April 1, vol. p. 502, detailed studies of operating costs and of the electric heating system were made. These disclosed that specific costs could not be isolated due to a multiplicity of factors and variables that enter into the operation. It was found that the quantity of asphaltic cement in the tank materially affects the quantity of heat required to raise or maintain the temperature. Atmospheric conditions, air temperature inside and outside the plant, wind directions which increased or decreased ventilation in the plant, all affected the quantity of electricity required to accomplish the same purpose from day to day. Under such conditions, it was decided that average costs determined from a full year of operations during which all factors were involved would be more reliable for whatever purpose they may be used.

A few average results of special interest were, however, determined concerning the quantity of electricity required to raise and maintain the temperature of asphaltic cement in the tanks. These results were based on tanks being full. Under these conditions, it was found that 119 watt-hours were required to raise one gallon of 60-70 penetration asphalt from 270 to 300 deg. F. This result is further based upon the fact that eight hours were required to secure this rise in temperature. A greater or lesser time during which the rise in temperature is secured will materially affect this result. Again with tanks full, it was found that 17 watt-hours per gallon were required to maintain the temperature at 330 deg. each day, and 14 watt-hours per gallon were required to maintain the temperature 275 deg. for the same period.

It should be noted that these results are average, and are based on the specific conditions set forth, and upon automatic thermostatic control of the heating elements. The results are of value in operations and design when consideration is given to comparable insulation and tank layouts. The results on the other hand are completely unreliable if used as the basis for determining overall operating costs because, strange as it may seem, it has been found that more electricity is required to accomplish the same purpose when the tank is half full than when it is completely full.

In developing the average costs of operation of this system several methods may be used in determining the costs in various forms applicable to the basis or comparison desired. Several costs established on differing bases will be developed later. Before undertaking this, however, a clear understanding must be had of the conditions under which the costs are developed to avoid confusion and misunderstanding.

The conditions at the plant during a period extending from October, 1944 to September, 1945, when the studies were conducted, are generally as follows: During this period 550,000 gal of asphaltic cement were consumed in 232 operating days and 365 days of raising and maintaining the temperature of this asphalt were involved. Production varied during this period from 50 tons per day on rainy or inclement days, for emergencies, to 380 tons per day in the summer during the paving season, and for one month no production at all to allow for vacations of field personnel. Weather conditions during this period varied from an extremely cold winter to a hot summer, including severe snow and a hurricane. Since field forces were materially reduced due to the manpower shortage occasioned by the war, the plant operated on one unit at a time, alternating operations weekly. With the exception of the low production rate, good average conditions prevailed.

Costs on a daily basis

In one method of determining costs, that of reducing costs of electric heating to a daily basis, the study indicated that the cost of raising and maintaining the temperature of asphaltic cement averaged $8.50 per day for each of the 365 days, and that the cost of heating the piping and other appurtenances averaged $5.50 for each of the 232 operating days. Combining these separate costs into one average cost, a cost of $12 for each of the 365 days is secured.

In an analysis of these costs it becomes apparent that the cost of heating the lines will not be affected by an increase in production, because all lines and appurtenances were heated on both units to assure operation in event of breakdown of either one of the units. Thus, the average cost of $5.50 for this purpose remains fixed. In the case of raising and maintaining temperature however, increase in production will increase the costs of this phase of the heating. The increase in cost is not proportional to the increase in production, because that part of the cost relative to maintaining heat will tend to remain fairly constant, and only the part relative to raising the temperature will increase. At full plant production, wherein a 50,000 gal. delivery would be used up

in about three days and if usual delivery temperatures of 300 deg. F. are maintained, the cost of maintaining temperature would decrease, together with the cost of raising the temperature.

Under this condition only one day of raising temperature would be required, while maintaining the temperature would be reduced to a minimum. Thus it may seem that the increase occurs between low and high production with greatest efficiency attained at maximum production. It is estimated that an increase in cost of as much as $5 per day may be encountered between the upper and lower limits of production. Applying this estimated increase to the average cost, a maximum cost of $13.50 would be required within the limits considered for average production. Again combining the cost of heating piping and cost of heating asphalt cement and using the estimated maximum cost of $13.50 per day, an estimated average total maximum cost of $17 for each day of the year is secured for such average production.

Costs on a gallonage basis

In another method, that of reducing costs to a gallonage basis, the study disclosed that the average cost of raising and maintaining the temperature of 550,000 gal. of asphaltic cement was about $2,950 or about 0.54c. per gallon.

Similarly, the cost of heating pipe lines and other appurtenances was about $1,270 or about 0.23c. per gallon. The total cost of heating was therefore 0.77c. per gallon. Here again the quantity of production affects the average costs. Since the heating of lines and appurtenances is constant regardless of the quantity of asphalt cement used, the cost per gallon decreases with increased use of asphalt almost in direct proportion. At full production, the cost falls to 0.04c. per gallon.

In raising and maintaining the temperature of asphaltic cement, although an increase is expected, a decrease occurs. Before clarifying this trend let us look at a condition that occurred in August, 1944, when no production was achieved and only the maintaining of heat was carried on. During this time, 30,000 gal. was maintained at 270 deg. F. at a total cost of $120 or at 0.13c. per gallon. This establishes a maximum cost for this phase of the heating. During operations this cost was reduced because tank capacities were reduced and then filled with high temperature asphalt cement.

Thus a reduction in this phase may be anticipated.

Further, the increase encountered in raising the temperature rises slowly while the increase in use of asphaltic cement increases at a greater rate, thus causing an overall decrease in costs on a gallonage basis. At full production the cost of raising the temperature falls to 0.09c. per gallon. At average production the cost of raising and maintaining the temperature may be estimated at 0.34c. per gallon. Combining the separate costs of heating the asphaltic cement and piping, an overall estimated cost of 0.15c. per gallon at full production and 0.44c. per gallon at moderate production may be secured.

In the computation of estimated costs, it will be noticed that no demand or labor costs were included. It is believed that this omission is justified for several reasons. Demand cost as indicated before is compensated for by the operating demand, and as long as the heating demand is not superimposed upon operating demand, the demand costs of the heating may be omitted.

Labor requirements small

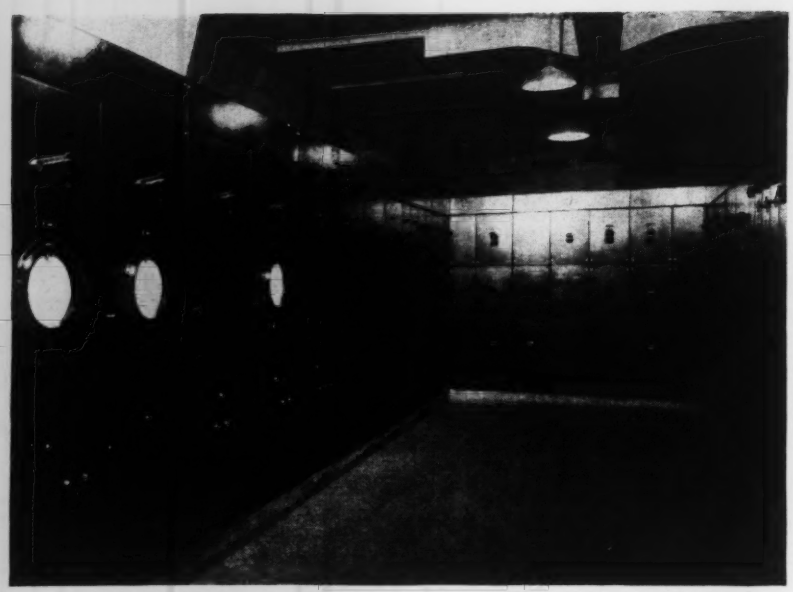
As for labor, all heating is conducted automatically once the circuits are set. Manipulation of push button stations and switches, and patrol for emergencies are so simple that the average night watchman can undertake this as a part of his routine rounds. Since the watchman must make hourly patrols through the plant, it takes little or no additional effort on his part to check operating conditions or manipulate switches at the appointed time on his rounds. Transfer of asphaltic cement and setting of automatic controls are done by regular plant personnel. Maintenance and repair except in a few instances discussed later have been negligible, reducing the care of this equipment to a preventive maintenance schedule. Since a complete preventive maintenance schedule has been set up for the entire plant, this work falls into the large program carried out by the plant electrician. Under these operating conditions, it is believed that labor costs may also be justifiably omitted.

Comparison with steam heat

In determining the value of a new method, the most common comparison is based upon a well established, operating old method. Since the conventional high-pressure steam method is almost universally used for heating in asphalt plants, this would serve best as a basis of comparison. In the conventional steam method, steam pressure must be maintained at all times to retain the heat, and narrow limits in temperature are difficult to attain. In electric heating, electricity is used only when required and then at an efficient minimum to attain the desired results. Further, when operating under automatic thermostatic controls, narrow limits of temperature can be maintained at maximum efficiency. This is particularly important where meters are used. Again in cases where a wide range in temperature that must be controlled within narrow limits is encountered, electric heating is far superior to steam heating. Generally speaking, the control of desired temperature is far simpler in electric heating. Further, leaky steam lines and valves are eliminated and a cleaner, more efficient operating atmosphere is attained.

In spite of all these advantages, the greatest factor of comparison is usually operating cost. From the previous discussion it was learned that average daily operating costs of $12 were established by the study and that a maximum average daily operating cost of $17 was estimated for electrical heating. Using the maximum daily cost as a basis, let us see how this compares with daily operating costs of the conventional method.

Assuming that initial installation costs are equal and, therefore, capital investment charges are equal, and that the cost of maintenance and repair differs but slightly, even though these assumptions give the advantage to the steam method, let us reduce the basis of comparison to cost of electricity on one hand to strictly labor on the other. In almost all localities the law requires that licensed stationary engineers and firemen be in attendance at all times at a high pressure steam plant. This is the case in New York City. In New York City



In the control room, indicator buttons show what circuits are open and temperature recorders reveal the condition of asphalt in the heating tanks.

the rate of pay for a licensed stationary engineer is about $14 per day and for a licensed fireman about $10 per day. Since both are required on the job a total cost of $24 per shift is required. On three shifts the cost is $72 per day.

Although heat is required for 24 hours a day, let us assume that the bulk of the steam during the day shift is used for other purposes, thereby reducing the labor cost chargeable to heating to $48 per day. Comparing this cost with the daily cost of electric heating, a saving of $31 per day in favor of electric heating, is attained. Since heat must be available 365 days a year, an annual saving of about $11,000 is indicated. Again, this saving is made on labor alone, and should have added to it the cost of fuel oil and water used in making the steam. During the year studied, it is estimated that even under the low production rate, the plant saved about $15,000 by virtue of its electric heating installation. Taking all phases of the operation into consideration in this plant, or it is believed in any other large stationary plant, electric heating is far superior in every way to the conventional steam heating.

The hardest people to convince of the value of a "new fangled gadget" are the old time plant men. When they agree that a new method is better, you can rest assured that you have something. Old time operators and mechanics swung from the old plant to the new. At first the usual reaction was manifested, "Wait and see, that junk will fall apart or blow up in a month. Then they'll use steam as they should have." Now the same men swear by it.

Like all new things, some difficulties developed that had to be cleared, the feel of the system had to be acquired, and an effective, efficient operational procedure developed. The operational procedure has already been discussed. The feel comes with experience. In this case, the setting of pipe line thermostats, the determination of time allowances for various operations, the number of heating elements used in relation to varying quantities of asphalt cement in tanks, timing of electrical controls and a host of other factors come with experience and will vary with every installation. The difficulties were not serious, but nevertheless caused grave concern at times until eliminated. In pipe lines and tanks that are emptied and heated empty before filling, great care must be exercised to avoid carbonization of the asphalt cement by excessive heat. In one case the contractor carelessly made a loop in the electric heating element when he found it too long for the section, then covered it and said nothing. No one knew about this until the pipe blocked solid with carbonized asphalt cement at the section where the loop had been made. The pipe was removed and replaced, a new heating element of proper length installed, and no further trouble was experienced.

In the surge tanks the method of heating is similar to that used in the main tanks. The surge tanks however, are emptied each day. The heating of the tanks each day prior to operating not only creates a heavy accumulation of carbonized material around the heating tubes, but also permits large pieces of carbonized material to fall into the tank from time to time. These pieces enter the pipe lines and jam meter, pump screens, pressure check valves and the piping itself. To control this, a cleanout manhole was installed in the surge tank and the accumulated carbonized asphalt is periodically cleaned out.

A better remedy would be the relocation of the heating element to the outside of the tank, as on the piping, thus eliminating entirely the carbonization on the tubes. This condition caused some misgivings as to the behavior of the tubes in the main tanks. An inspection, however, dispelled all concern, because these tubes being always immersed in asphalt cement caused no carbonization.

Electric heating of the asphalt system in this plant has proved highly effective and efficient, extremely economical and eminently satisfactory. Its operation, once co-ordinated with the plant is simple and its maintenance insignificant. When properly designed and installed, it eliminated many of the troubles of steam heating, such as foaming asphalt from steam leaks, freezing of steam lines, and massive jacketed fittings. In spite of these favorable characteristics observed in this case, electric heating may not be applicable in every plant. It should be noted that low cost power must be available, with rising costs of fuels, the importance of this factor diminishes; that plant power demand must equal or exceed the power demand of the electric heating system, otherwise demand costs must be added to electric consumption costs, thereby offsetting the economy of the system; and that all pipe lines, tanks, and equipment heated should be fully insulated and if possible housed in order to reduce heat dissipation to a minimum.

Fig. 1. A lamp warehouse at Trenton, N. J., is connected to the factory by a 600-ft. bridge carrying three conveyors.

Trends in Industrial Plant Design

Contents in Brief—Industrial buildings under construction in 1947 were characterized by great variety in materials utilized. In many cases, availability of a certain material for immediate delivery was a controlling factor in the determination to use a particular type of design.

SIGNIFICANT developments in design and construction of industrial buildings are noteworthy, but emphasis on innovations often creates a false impression of what generally is being done. Thus, to keep the record straight, a brief report on 1947 industrial buildings follows.

For most of these structures, construction materials were selected and used much as in pre-war years. Shortages of some materials, however, quite often necessitated use of alternative designs to insure deliveries on schedule. As a result, resort was had to a wider variety of building products last year than was common before the war.

Trends in layout and design continued substantially the same as outlined in "Controlled Conditions Buildings" (*ENR* May 16, 1946, vol. p. 784), "Trends in Factory Layout and Design" (*ENR* May 30, 1946, vol. p. 840), and "New Trends Develop in Southern Textile Mill Design" (*ENR* May 15, 1947, vol. p. 805).

Several industrial buildings have been selected to illustrate the more outstanding trends. Following is a brief description of these plants:

WAREHOUSES — The Westinghouse Electric Corporation's 272,000-sq. ft., one-story and basement lamp warehouse at Trenton, N. J., is irregularly shaped in plan, having 11 sides (Fig. 1). Exterior walls of common brick with concrete-block back-up support the structural steel beams, and a 2-ft. high strip of sash extends around the perimeter. The roof deck is cast-in-place gypsum, which rests directly on open-web steel joists. A 600-ft. long conveyor bridge connects the warehouse and the main plant.

Fig. 2. A pipe warehouse at Lorain, Ohio, utilizes radiant heating. For lighting, incandescent and mercury-vapor fixtures are alternated.

Floors are elevated to car-door height throughout to service two sidings. Over the basement, they consist of 2½ in. of concrete supported on open-web joists. They are reinforced with wire mesh, which with an attached waterproof paper also served as a form. Lighting is incandescent, and heating is by steam unit heaters to a 55-deg. level.

In contrast, the 125x1,326-ft. National Tube Co. warehouse in Lorain, Ohio, is illuminated by a combination of mercury-vapor and incandescent lamps, providing 11 foot-candles at floor level (Fig. 2). It is radiant heated with hot water flowing through 481 coils of 1-in. pipe embedded in the 10-in. thick reinforced concrete floor.

Designed and built by the American Bridge Co., the building is of steel-frame construction, with side walls of brick to 6 ft. above the floor and corrugated sheathing to the eaves. The roof is steel deck covered with 1 in. of insulation and a composition topping.

MANUFACTURING PLANTS — As an example of a controlled-conditions building, there is the Bayer Co. aspirin factory at Trenton, N. J. (Fig. 3). Designed and built by The Austin Company, the one-story plant is

Fig. 3. Floors of an air-conditioned aspirin plant at Trenton, N. J. are protected with acid-resisting tile. The walls are faced on the inside with glazed ceramic tile.

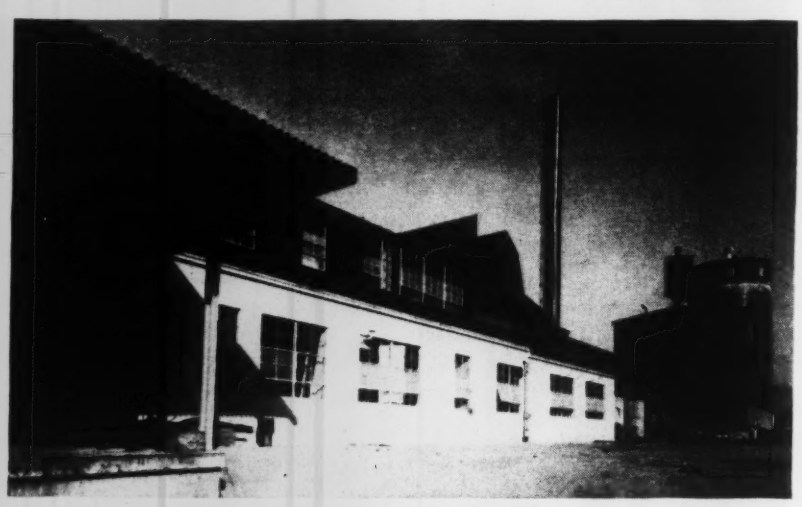


Fig. 4. Asbestos-protected metal forms the walls and roof of a glass factory at El Monte, Calif., except for short sections where concrete was used.

equipped with seven separate air-conditioning systems. Air in some areas is changed every 3½ min.

The welded rigid-frame structure is faced on the exterior with buff face brick and continuous bands of sash and glass block, and on the inside with ceramic tile. It has an overall length of 340 ft. and ranges in depth from 170 to more than 200 ft. The roof is precast concrete, and floors are covered with acid-resisting tile.

Another Austin Company job of interest is the glass plant built for the Ball Brothers Co. of California at El Monte. It consists of a small office building, a glass factory and warehouse (Fig. 4), with a total of 125,000 sq. ft. of floor, a 29,000-sq. ft. cap plant and a 16,000-sq. ft. cap liner plant.

The manufacturing buildings are of steel-frame construction, covered with protected-metal. Lighting is fluorescent or incandescent.

Heavier construction is used for the General Electric Co. one-story, 650x1,300-ft. turbine factory, with a 3-story office section, designed and being built at Schenectady, N. Y., by the Stone & Webster Engineering Corp. (Fig. 7). It is of steel-frame construction, with general column spacing 40x50 ft. In the crane bays, columns are spaced 50x80 ft. Exterior walls consist of cast-in-place reinforced concrete spandrels, steel sash, and protected-metal siding backed up with 1½-in. of asbestos-cement board with cane-fiber core. The roof is steel deck covered with 1 in. of insulation and built-up roofing.

Trends in the design of automobile

Fig. 5. One-story Ford Motor Co. assembly plant at Metuchen, N. J., provides 629,435 sq. ft. of floor space. Employee facilities are incorporated in a mezzanine located near the center of the building.

assembly plants were described in *ENR* Oct. 31, 1946, vol. p. 599. No significant changes can be reported. Some designed by Albert Kahn Associated Architects and Engineers, Inc., may be used as examples. Three factories like the one at Metuchen, N. J. (Fig. 5), one-story high, steel-frame structures, with a mezzanine housing employee facilities bisecting the plant, are being built by Ford Motor Co.; and a somewhat different type is being erected by General Motors Corp. (Fig. 8).

PUBLISHING PLANT—As an example of reinforced concrete construction, there is the 146x290-ft., 4-story and basement Gravure Press Building designed and built by The Austin Company for the Crowell-Collier Publishing Co. at Springfield, Ohio (Fig. 6). The extreme height of the floors (24 to 28 ft. clear) and high load-carrying capacities (400 psf.) presented interesting form problems, which were met by the use of shores three tiers high. Patented steel forms were used for the columns and plywood for the flat-slab floors. A total of 12,000 cu. yd. of concrete, with a cement dispersing admixture incorporated, was placed by a pump with 60-cu. yd. per hr. capacity. Forms could be shipped in three days.

For the future, in the light of newer materials used in 1947, it may be expected that greater use will be made of aluminum in building exteriors. Insulating materials also may be used more extensively. And the trend toward panel construction, using sandwich materials, will probably gain momentum.

Fig. 6. Direct lighting for printing operations in a Springfield, Ohio, plant is built into the presses. Lamps high on the columns provide general illumination.

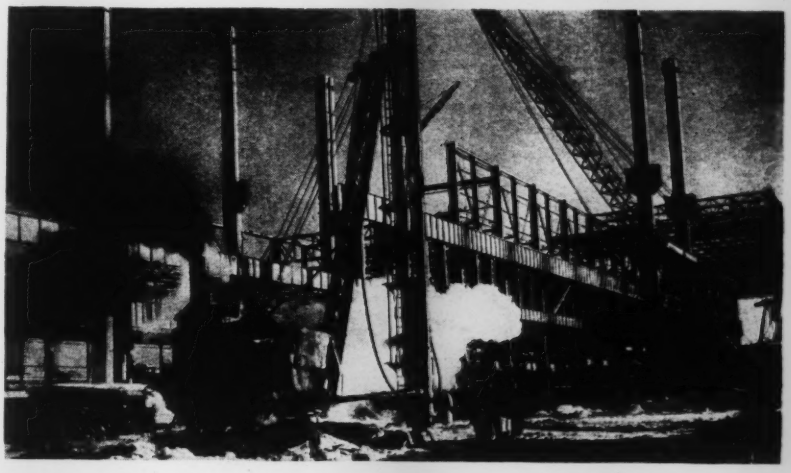


Fig. 7. Heavy steel construction for a turbine factory at Schenectady, N. Y., is carried on piles. Cranes of 200-ton capacity will be installed.

Fig. 8. The two-story Chevrolet and Fisher Body plant at Flint, Mich., provides 1,103,545 sq. ft. of floor. A basement contains employee facilities, including cafeteria and lockers. Paved parking areas total 250,000 sq. ft.

Fig. 1. Towers for the Commodore Heim Bridge extend 184 ft. above pier. Existing bascule bridge shows between the piers.

Lift Bridge Provides 175-Ft. Clearance

Contents in Brief—Largest vertical lift bridge in the Far West, the Commodore Schuyler F. Heim Bridge recently completed in southern California provides connection between Terminal Island in the Long Beach and Los Angeles harbor area with those two cities. With vertical clearance of 50 ft. in the down position and 175 ft. in the up position, the 840-ton span is lifted 125 ft. Allowance was made in design for possible horizontal movement due to general subsidence in this region.

RECENTLY COMPLETED under Navy jurisdiction in southern California, the Commodore Schuyler F. Heim Bridge is the largest vertical lift bridge in the West with an 840-ton lift span that is 240 ft. long. Clearance varies from 50 ft. with the lift span in the down position to 175 ft. with the lift span raised. The length of travel, 125 ft., is believed to be the greatest of any lift bridge in this country and the lift span deck area, providing for six traffic lanes (two 35-ft. roadways) and a center dividing strip, ranks the bridge among the largest in the country in that regard.

Except for the size of the structure and some details there is, as one of the engineers most vitally interested in design put it, "nothing particularly new in the design of this structure; it is just a big bridge." Details of interest include provisions for accommodating horizontal displacement due to subsidence in the area where the bridge is located and center hangers from the overhead cross-bracing to the deck to reduce the span and depth of the floorbeams.

The over-all length of the bridge project is almost 4,000 ft. However, most of this is taken up in approach viaducts, the lift bridge proper, with two side spans having a total length of 700 ft. Longitudinal trusses are 86 ft. apart. To span this width relatively large floorbeams would be required. Large beams on the lift span would mean less clearance for shipping passing underneath the bridge. Accordingly, the designers took advantage of the center dividing strip and provided hangers of 14-in. WF beams connecting the overhead trussed bracing with the center of the floorbeams carrying the deck.

Allowance for lateral displacement

A second design detail of interest did not enter the picture until construction of the bridge was well under way. The project was conceived in 1940 when work was starting on the Naval Operating Base located on Terminal Island. Original location surveys were made at that time, and reference staking was done in Decem-

ber, 1944. However, when actual job staking was commenced in the spring of 1946, it was found that actual distances between reference stakes did not agree with recorded distances. After a series of precise surveys it was found that the distance between the banks of the channel to be spanned had decreased some 3 in. in about 17 months. This movement was incidental to the general subsidence of the Long Beach area, the cause of which is complex but is believed to include the pumping of oil from the underlying shales and the effect of tectonic forces (*ENR* Aug. 23, 1945, vol. p. 239).

Continuous observations have shown that the movement has continued intermittently since first observed. The width of the channel has been decreased by 5¼ in. in the course of 36 months. A similar shortening has occurred in the ground on each bank of the channel, its magnitude decreasing as the distance from the channel increases. The over-all effect has been a decrease of 14¼ in. in 22 months in an original distance of 8,384 ft. covering the freeway project.

This horizontal displacement caused some concern to the engineers and designers so allowance was made for future movement by providing means whereby the main span could be shortened as much as 12 in. and each side span as much as 9 in. This allows a total narrowing of the channel of 30 in. before major work on the structure will be necessary. The spans are shortened by adjusting the bridge shoes and lift span supports.

Fig. 2. Center hangers extending through the traffic separation barrier reduce the size of beams required to support the bridge pavement. Note barrier height.

More than normal movement allowance was also made in the bridge expansion joints.

In addition to the allowance for horizontal movement of the bridge, provision has been made so that the towers can be plumbed in case of differential settlement by jacking the legs and installing steel shims under bearing plates.

Although the lift span is 240 ft. long, horizontal clearance for shipping purposes is only 180 ft. because the bridge and channel are on a slight skew. The lift span is raised by use of four 100-hp. motors, one in each tower leg. Weight of this span was reduced by the substitution of an open grid floor for the concrete pavement.

An existing bascule bridge paralleling the new bridge has not been operable since 1946 because the horizontal movement of the channel banks accompanying the settlement of the area has "frozen" the mechanism. Now that the new lift bridge is in service, the bascule bridge is being taken out of service for repairs. When returned to service, the bascule will be held in open position except for such times of the day as it is needed for rail traffic. All other traffic will use the new bridge.

Freeway provides island access

The Commodore Heim Bridge crosses Cerritos Channel and is part of the Terminal Island access freeway

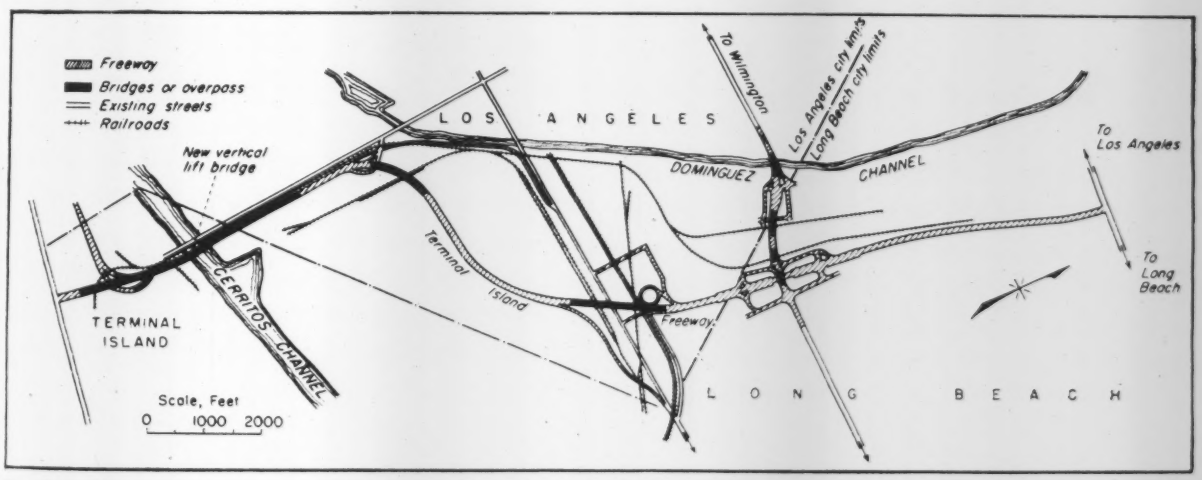


Fig. 3. The new bridge is part of a freeway project aimed at reducing rush hour traffic jams on roads leading to Terminal Island. The southern California freeway system will eventually tie into the recently completed project.

project. The channel provides an inland deep water (35 ft.) connection between Long Beach and Los Angeles harbors. The freeway project was conceived even before the war to provide more ready access to the island and the naval, military, and industrial installations thereon. At rush hours during shift changes, severe traffic jams frequently occurred. So, in addition to the bridge, several miles of freeway with eight other structures (bridges and overpasses) were involved. Work on the freeway fill and approaches for some of the structures required use of vertical sand drains (*ENR* Mar. 6, 1947, vol. p. 386).

The bridge and the freeway were designed by the California State Division of Highways. However, as all financing came through federal agencies, administration of the project was undertaken by federal groups. The Navy, one of the most vitally concerned federal groups, supervised construction of the bridge and its immediate approaches. The Public Roads Administration was responsible for the remainder of the project but it "sublet" the detailed design and construction supervision to the State Division of Highways. Total cost of the project was about $12,000,000 with more than $5,000,000 being the cost of the lift bridge and its immediate approaches.

Piers built on H-piles

Construction of the main portion of the bridge began with the central piers. The bottom for an area 60x120 ft. was excavated to final elevation for the bottom of the piers. Steel H-piles for support were then driven underwater with cut-off some 44 ft. below high water level. Then cofferdams of steel sheetpiling were driven around the 60x120-ft. area and a tremie plug 10 ft. thick poured, after which the cofferdams were unwatered.

The contractor, in a time-saving attempt, used a concrete pumping method on the first of these two pours (2,700 cu. yd.). However, some trouble was encountered in that the concrete would not flow to a relatively level position but built up around the pipe. This required many more changes of the piping set-up than were expected and considerable leveling work after dewatering because of the resulting uneven surface. On the second cofferdam, the standard hopper and tremie pipe were used with relatively little trouble.

Some 45,000 cu. yd. of concrete was required on the bridge job on the piers and approach bents and pavement. Concrete was hauled in truck mixers and distributed to the approaches by means of cranes and buckets suspended therefrom.

The lift bridge was under the supervision of Capt. H. E. Wilson, CEC USN, officer in charge of construction until October, 1947, when he was relieved by Capt. C. W. Coryell, CEC USN. Comdr. J. W. Frorath, CEC USN, was contract superintendent and project manager. The bridge was designed by the bridge department of the California State Division of Highways under the direction of F. W. Panhorst, bridge engineer. United Concrete Pipe Corp., contractor on the job, let subcontracts to Columbia Steel Co. for the steel, American Bridge Co. for steel erection and to J. D. Proctor, Inc., and B. W. Kuhn for foundations.

Slums Increase Disease, Death and Taxes

Relationships among disease, death and taxes in the slums have been high-lighted recently by studies in Cleveland, San Francisco and Cincinnati.

The National Association of Housing Officials cites studies of slums and housing as new evidence of how high disease and death rates in blighted areas, plus their excessive fire and police protection costs, impose heavy added tax burdens on those living in better neighborhoods.

In Cleveland, a study sponsored by Western Reserve University provides spectacular examples. The study analyzed long-term results of razing a five-block slum in that city and replacing it with a new housing development named Carver Park. Population of the area is about 5,000.

Redevelopment brought these results: Crime in Carver Park decreased 17.5 percent from 1942 to 1947. During the same period in an adjacent slum area (among a carefully-matched group of families), crime increased about nine percent.

The tuberculosis rate in Carver Park decreased 54 percent following redevelopment. Per unit population, the rate of TB infection was more than twice as great in the adjacent slum than in the housing project.

Pay-off for the taxpayer who doesn't have to live in the slums can be measured this way: If the slum had not been removed, the city would have had to spend an estimated $25,000 a year more in relief rentals, $11,000 more in fire protection costs, and $25,250 more in tuberculosis care.

In San Francisco, the planning and housing association compared a slum area and the Marina District, an average well-kept neighborhood, and came up with similar results. Both areas had populations of about 12,000.

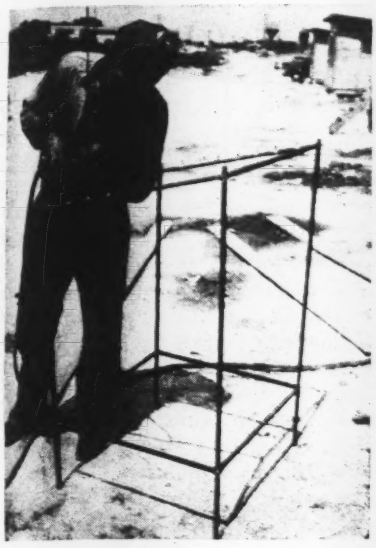
Health figures disclosed that the slum had 36 times as many TB cases as the Marina. The slum had twice as many fires as the Marina. Three babies died in the slums for each one who died in the Marina. While 39 Marina adults were arrested, there were 4,771 adult arrests in the slum area.

The message for the taxpayer is this: In 1946, the cost to San Franciscans of maintaining city services in the slums, as compared to the Marina district, was twice as great for fire protection, four times as great for juvenile courts, 89 times as great for police protection. Health costs were 100 times higher in the slums.

In Cincinnati, a study by the public-health federation revealed that the city's death rate would be about 15 percent lower were it not for the high mortality in the slums. The pneumonia and tuberculosis death rate averaged three times as high in the slums as in the city at large. Accidental deaths occurred twice as often in the slums, and the homicide rate was four times that of the city as a whole.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS



Blueprint Rack Built of Reinforcing Steel

With a few scraps of reinforcing steel and a little welding rod, a workman of the R. H. Wright and Sons firm, the general contractors, quickly built a sturdy rack for the several groups of blueprints being used on a highway project near Miami, Fla. Once the welded frame had been built, a welding rod was secured to the top of the frame at an even spacing as shown and then burned off to provide stubs about 1 in. high. These stubs prevent the drawings from sliding to the lower end of the frame. The rack, despite its small cost is very serviceable.

Proper Bedding Prolongs Life of Buried Water Pipes

The cause of most water main maintenance jobs is often found when the pipe is uncovered for making the repair. It is not unusual to find the pipe resting on a rock, a concrete footing, stump, or some other rigid object (Fig. 1). Such supports concentrate the weight of over-burden producing large beam and ring stresses in the pipe at the point of contact. This effect may be magnified further if the trench has been excavated with an uneven bottom. All rocks and other hard objects should be removed before installing the pipe. If the main is being laid through rock, the trench should be excavated 6 to 8 in. below the proposed grade. A uniformly compacted cushion of sand, clay or fine screenings should be provided in this space.

Water mains are subject to the earth-backfill load as well as the weight and impact of heavy trucks passing along the street (Fig. 2). These loads produce a heavy strain on pipe installed on blocks unless the backfill has been tamped around and under the pipe to provide uniform support for the entire length. Water mains are designed to carry water and not to serve as beams.

The use of blocks may give rise to undue stresses between the blocks that will result in pipe failure. At Iowa State College, by actual field experiment, it has been shown that a 6-in. water main laid on blocks is subject to two and one-half times more load than one laid in a smooth-bottom trench. A level trench bottom accompanied by tamping of backfill up to the pipe centerline provides uniform bedding that will minimize breakage.—DEWEY W. JOHNSON, *Cast Iron Pipe Research Assn., Chicago, Ill.*

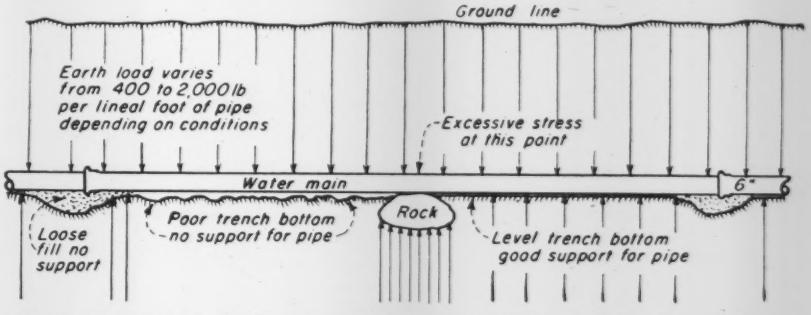

Ground line
Earth load varies from 400 to 2,000 lb per lineal foot of pipe depending on conditions
Excessive stress at this point
Water main
6"
Loose fill no support
Poor trench bottom no support for pipe
Rock
Level trench bottom good support for pipe

Fig. 1. Rigid objects under water mains cause formation of high stresses in pipe which may lead to breakage. A uniform subgrade and a compacted cushion distributes loads and prolongs pipe life.

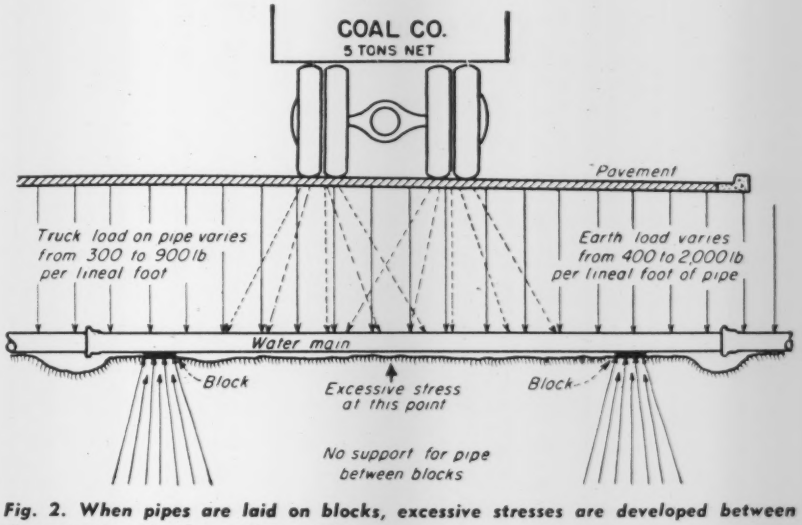

COAL CO.
5 TONS NET
Pavement
Truck load on pipe varies from 300 to 900 lb per lineal foot
Earth load varies from 400 to 2,000 lb per lineal foot of pipe
Water main
Block
Excessive stress at this point
Block
No support for pipe between blocks

Fig. 2. When pipes are laid on blocks, excessive stresses are developed between the supports. Breakage often results.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

U. S. Highway Aid for Turkey

Sir: The $5,000,000 allocation—for highways from the U. S. $100,000,000 Turkish aid fund consists of American equipment—some army equipment already in Europe—and technical services such as the PRA group is supplying. The Turks are contributing the funds for actual highway construction.

As doubtless you know, the Turkish highway system, such as it is, had German, French and British engineering services in prewar days. Most of the Turkish engineers now in authority are European trained, principally in German universities, although a prominent exception is Vecdi Diker, highway engineer of the Turkish Ministry of Public Works who attended the University of Missouri. Many of the younger engineers are American university trained, but they have not yet risen to commanding posts generally. Roberts College and the Istanbul Engineering Faculty are the principal sources of Turkish-trained engineers. Unfortunately, here—as well as in American universities—the tendency is to endow the holder of an engineering degree with all engineering knowledge, both theoretical and practical. However, the admiration of the Turkish engineers for American methods and American equipment, as well as the genuine good will toward our country, make us doubly anxious to do our best in helping them to modernize their highway system.

In common with other foreign countries, Turkey is shy of dollars to buy equipment and materials not available from local sources. This handicaps bridge construction especially, as the Karabuk steel mills roll only rods and a few small shapes usable on bridges. The amount of structural timber is limited, and not a great deal of cement apparently can be diverted from other essential construction. In the past, steel bridges were fabricated in Germany or Czechoslovakia, hence required foreign exchange, so the emphasis has been placed on reinforced concrete generally. Accordingly, we have an interesting problem in getting low-cost bridges built rapidly.

FRED D. HARTFORD
ANKARA, TURKEY

EDITORS NOTE—The above is taken from a personal letter from Mr. Hartford who is bridge engineer of the Public Roads Administration group attached to the American Mission for the Turkish Aid Program.

Behavior of Wood

Sir: Since the publication of my article "Behavior of Wood Under Continued Loading" in the Dec. 11, 1947 issue, vol. p. 804, I have had a number of communications requesting additional information or clarification on certain points. The answers to some of these inquiries may be of interest to your readers.

The term "normal strength" used in characterizing stresses in long-time loading seems to have been confusing to some. It should be emphasized that "normal strength" as used here is not a working stress level but is the ultimate strength obtained in laboratory tests of "normal" duration, usually 5 to 10 min. All working stresses for wood are considerably less than this laboratory strength value. One of the reduction factors in converting the laboratory strength to a working stress is the duration-of-load factor as discussed in the article.

The last two paragraphs of the article refer to duration effects on stressed wood members in unstable equilibrium (long columns and deep narrow beams), and there has been inquiry as to the amount of these effects. Quantitative measurements are lacking, and I suggest that this is a useful project for research. In general, it appears that the accepted rules for reducing loads on long columns or for lateral support of deep narrow beams are adequate but not conservative for long-time loading conditions.

Mention is made in an early section of the article of the relation of yield to stress, and it has been asked how this is obtained from constant-load tests. Data from a number of specimens loaded to various stress levels are brought together, and amounts or rates of yield at a stated time (*e.g.*, one day) are compared, thus eliminating time as a variable and showing the relation between yield and stress.

There have been requests for a more complete report or publication on long-time loading of wood. The Forest Products Laboratory does not have any more complete report available, although it is hoped that one can be prepared within a year or two.

There is a dearth of American literature on this subject. The most advanced treatment known to me has been made at the Russian Academy of Sciences, but much of their latest work probably is not available for review. The Australian Council for Scientific and Industrial Research has begun a program of investigations and has released a few reports, mostly of preliminary nature.

LYMAN W. WOOD
Madison, Wis.

Rhine Bridge

Sir: Referring to the discussion about "Rhine Bridges" (*ENR* March 4, 1948, vol. p. 373) and to the question of Dr. Steinman:

The highway bridge over the Rhine at Duisburg-Rheinhausen (not Hochfeld), originally called the Admiral Graf Spee Bridge, was actually built according to the sketch Fig. 19 on vol. p. 599 of the Oct. 30, 1947 issue with spans of 153.45 m. and 255.75 m., which means 500 and 850 ft. There are only two spans and not four.

The bridge was built in 1934/1935. If more detailed descriptions are desired, they can be found in the German Zeitschrift Verein Deutscher Ingenieure 1936, page 461, and also in the German magazine "Die Strasse" 1936, page 368.

EMIL SCHAEFFER
Consulting Engineer
Elizabeth, N. J.

EDITOR'S NOTE: Apparently the extra piers shown in Fig. 19 of the Oct. 30, 1947 issue were added during the war as a temporary precaution against bombing, so that as Mr. Schaeffer points out, the bridge was originally of only two spans and as a consequence a very notable structure.

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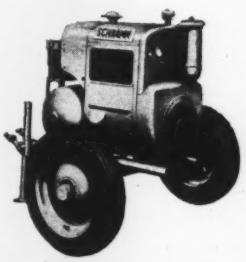
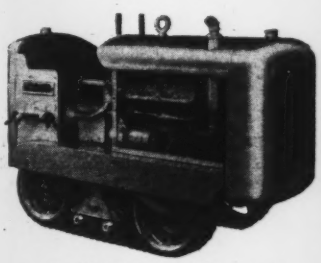
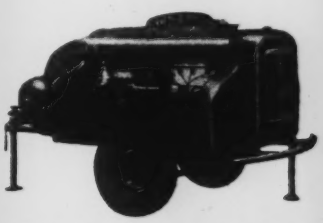


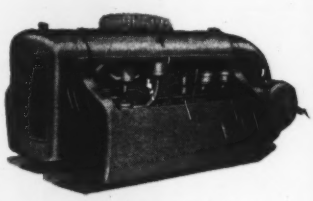
20/35 Model Compressor



No. 60 Self-Propelled Compressor

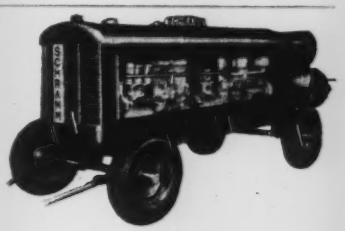


Two-Wheel Trailer Mounting with Tool Boxes

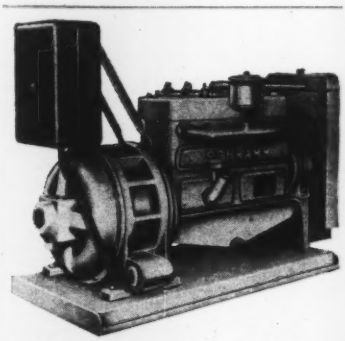


Skidded for Truck Mounting

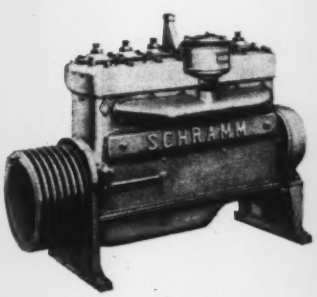
Truck Mounted



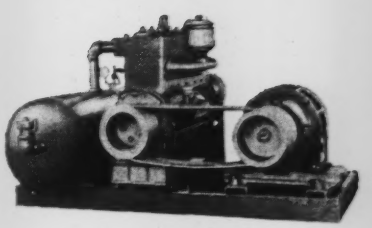
Diesel Engine Drive



Built-in Motor Drive with Cooling Unit and Starter



"V" Belt on Flat Pulley Drive



"V" Belt Drive with Air Receiver

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents
May Materials and Labor Prices will appear in the May 13, 1948 issue

CEMENT, AGGREGATE, READY-MIXED CONCRETE — F. O. B. CITY

	PORTLAND CEMENT* Per bbl. C/L lots incl. $1.00 per bbl. for bags, cash. dis. not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block		READY MIXED CONCRETE 1:2:4 over
	Cloth	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand grav.	Lt.wgt.Agg.	50 c.y. del.
Atlanta	$4.03	$3.26	$2.98	$2.00	$2.00	$1.75	$2.10	$2.10	$1.65	$1.85	$0.1725	$0.1725	$11.00
Baltimore	3.91	3.14	2.86	2.20*ff*	2.20*ff*	1.80*ff*	2.40*ff*	.....	2.35*ff*	2.35*ff*	.15	.15*w*	9.20
Birmingham	3.65	2.88	2.55	2.06	2.06	1.66	2.50	2.50	1.00	1.20	.15	.15	7.45
Boston	4.39	3.62	3.34	1.50‡*t*	1.50‡*t*	1.40‡*t*	1.25‡*t*	1.35‡*t*	....	....	.186	.195*w*	10.50*m*
Chicago	3.65	2.88	2.60	2.75‡*d*	2.75‡*d*	3.20‡*d*	2.60‡*d*	2.60‡*d*	2.00‡	2.00‡	.20	.20*x*	....
Cincinnati	3.87	3.10	2.82	1.85‡*pp*	1.85‡*pp*	1.75‡*pp*	2.75‡*bb*	2.75‡*bb*	2.20	2.20	.19	.195	10.05*hh*
Cleveland	3.82	3.05	2.72	1.90*lig*	1.65*llg*	1.45*ll*	3.45‡*h*	3.45‡*h*	2.60	2.60	....	.21	11.20*aa*
Dallas	3.57	2.80	2.52	2.00	2.15	1.75	2.00	2.10	....	....	.0775*p*	.255	8.85
Denver	.....	3.32	3.02	1.85	2.00	1.15	....	....	....	....	.20	.2175*w*	9.65
Detroit	3.67	2.90	2.62	3.00‡	3.00‡	2.75‡	2.75‡	2.75‡	2.75‡	2.75‡	.17	.18*w*	9.15*kk*
Kansas City	3.68	2.88	2.63	2.05	2.05	1.40/1.60*t*	1.45*q*	1.45*q*	....	....	.16*wf*	.175*ay*	9.85*n*
Los Angeles	....	3.60*b*	3.20*b*	1.92*t*	2.02*t*	1.72*tnn*	1.92*t*	1.92*t*	....	....	.085*oo*	....	9.96*m*
Minneapolis	3.91*dd*	3.14*dd*	2.86*dd*	2.10*h*‡*j*	2.10*h*‡*j*	1.20*h*‡*j*	2.20*h*‡*j*	2.20*h*‡*j*	....	....	.19*cco*	....	10.05*jkk*
Montreal	....	2.29*r*	2.14*r*	1.75*bbs*	1.75*bbs*	....	1.55*cs*	1.75*cs*	....	....	.1936	.2265*w*	7.75*ls*
New Orleans	3.63	2.86	2.58	2.13	2.13	1.82	....	....	.90	1.15	.23	....	10.65
New York	....	4.00‡	....	1.85*de*	1.85*de*	1.30*de*	2.00*dv*	2.00*dv*	....	....	.18*ii*	.174*wccii*	10.50*k*
Philadelphia	3.71‡	2.94‡	2.66‡	2.30‡	2.40‡	2.05‡	1.90‡	1.95‡	1.50	1.50	.22/.25	.22/.25*w*	9.85
Pittsburgh	3.78	3.01	2.73	2.05‡	2.05‡	2.35‡	2.50‡	2.50‡	2.05	2.05	.22*z*	.22*z*	10.85
St. Louis	3.76*o*	2.99*o*	2.71*o*	2.35‡*oh*	2.35‡*oh*	2.00/2.35‡*oh*	1.50*c*	1.50*c*	1.10	1.15	.20	.22*yo*	10.40
San Francisco	.....	3.38	2.98	1.84	1.84	1.94	1.94	....	....	....	....	.25*y*	10.75*u*
Seattle	.....	3.45*mm*	2.95*mm*	2.75‡*od*	2.75‡*od*	2.75‡*od*	3.50‡*od*	3.50‡*od*	....	....	.22*o*	....	9.75*o*

‡ Delivered. *a* F.o.b. truck at plant. *b* 10c. per bbl. off for payment by 10th of following month. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks, Man. *f* F.o.b. truck on job. *g* Pea gravel. *h* Truck Lots *i* ½ in. *j* 5% discount for cash. *k* 5 cu. yds. or over, del. Man. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* F.o.b. truck at plant. *r* 10¢ per bbl. off cash 20 days. *s* Sales tax included. *t* Truck delivery. *u* 10 to 100 c.y. brackets. *v* F.o.b. scow, Hudson River, N. Y. Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Aver. haul, 7–9 mi. zone. *ub* Under 5 tons. *cc* 8 x 8 x 18 in., 18.2¢. *dd* Dealers sell only in LCL. This is price for CL and does not include dealer's commission. *ee* 20c refund for each returnable bag. *ff* LCL. *gg* 10c. refund for each returnable bag. *hh* Truck loads up to 500 c.y. Over 500 c.y lots, 50¢ less per yd. *ii* Yard price. *kk* 2500 lb. compression strength *jj* 30¢ refund for each returnable bag. *ll* Price at plant, called for. *mm* 10¢ per bbl. off cash 10 days. *nn* Concrete sand *oo* 4x8x12 std. wgt. *pp* 5 tons or more. *Prices include dealer's commission except where indicated to the contrary.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add $1.05 per bbl.; 25c. refund allowed for each returnable bag; for paper bags add 28c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$2.10	$2.10	Ironton, Ohio	$2.15*	$2.15*	Universal, Pa.	$2.20	$2.20
Hannibal, Mo.	2.20	2.20	Northampton, Pa.	2.15	2.15	Waco, Tex. (Plus 9c. tax in Tex.)	1.95	1.95
Independence, Kans.	2.20	2.20	Richard City, Tenn.	2.20	2.20	Montreal City (Discount 10c. per bbl. 20 days)	1.98	1.98
* Destination price base effective Dec. 22, 1947			Steelton, Minn.	2.30	2.30			

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS — F. O. B. CITY

	PAVING BRICK AND BLOCK Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	PAVING ASPHALT Per ton, less than 80 penetration Tank car	Drums	ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration Tank car	Drums	CUTBACK ASPHALT Per ton Tank car	Drums	ROAD OIL Per gal. Tank car	ASPHALT EMULSION (Quick-breaking) Per gal. Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	$14.00	.....	$0.074	.....	$0.0806*h*	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70‡	.....	15.00	$21.00	.0925	$0.1225	15.00	$25.00	.095*v*	.095	$0.115
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	85.00	59.00	3.75	17.00*o*	29.50*o*	.0723*o*	.1447*o*	.075*ho*	.15*ho*	.07*o*	.0907*o*	.18*o*
Chicago	150.00‡*y*	80.00*e*‡	2.97/4.10*d*‡	22.50*b*	32.00*b*	21.50*bg*	31.00*bg*	.097/.10*bh*	.....	.082/.0845*b*	.0925/.1025*b*	.14/.165*b*
Cincinnati	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	186.52	49.00*t*	3.84*u*	28.00	38.00	27.00*g*	37.00*g*	.13*h*	.21*h*	.125	.20	.27
Dallas	*l*	40.00	*l*	23.38	42.17	.0987	.1837	26.15	46.65	.0962	.1037	....
Denver	.....	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	63.00*x*	.....	20.00	26.00	18.40*g*	24.40*g*	.0811*h*	.128*h*	.075	.1085	.1522
Kansas City	.....	40.00*g*	.....	20.45*r*	.....	.....	.....	.081*hr*	.....	.071*r*	.....	.....
Los Angeles	*l*	.....	*l*	16.00*mf*	32.75*mf*	16.00*gm*	32.75*m*	16.50*m*	33.25*m*	15.50*gm*	.0675*cc*	.1375*cc*
Minneapolis	.....	.....	2.79*d*	28.00	37.00	23.00*g*	34.00*g*	27.00	38.00	.105	.13	.23
Montreal	125.00	.....	.....	21.60*k*	31.25*k*	14.10*kp*	18.35*kp*	14.00*kp*	16.00*kp*	12.50*kj*	.153*k*	.194*k*
New Orleans	.....	.....	.....	20.00*a*	.....*s*	20.00*a*	.....*s*	9.50*a*	.....*s*	.095	.0975	.16*n*
New York	.....	.....	2.50*d*	25.95	36.35	24.95*g*	42.79*g*	.1068*h*	.1832*h*	.1018	.1066	.1889
Philadelphia	150.00	62.00	4.06	23.00	.....	22.00*g*	.....	.095*h*	.....	.....	.....	.....
Pittsburgh	165.00	42.00	4.10	26.00	39.00	.12	.24	27.00	42.00	.095	.10	.21
St. Louis	.....	48.50	.....	16.50/17.50	22.50/23.00	15.50/16.00*g*	21.50/22.00*g*	.075/.08*h*	.165/.17*h*	.065/.07	.075/.095	.125/.155
San Francisco	.....	57.75*c*	.....	16.50	33.75*w*	16.50*g*	.....	17.50	.....	.....	.0625	.1325
Seattle	.....	.....	.....	16.50*i*	33.00*i*	15.00*ig*	.....	18.00*i*	22.00*aai*	16.00*ij*	.0625*i*	.0725*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. refinery. *c* 2¼ x 8¼ x 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½. *f* 40–80 penetration. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* Shipped in drums, per drum. *k* Tax included. *l* Not used. *m* F.o.b. refinery, El Segundo. *n* 55 gal. drums. *o* Price at plant, in Everett. *p* Per 100 gal. *q* F.o.b. Buffalo. *r* F.o.b. Sugar Creek, Mo. *s* Drums not available. *t* Truck deliveries in Greater Cleveland. *u* 3-in. *v* Bulk, refinery. *w* Shipped in double head wood barrels. *x* Truck deliveries in Detroit $75.00 *y* Carload lots. *aa* In customer's drums. *cc* F.o.b. refinery, Inglewood.

IRON AND STEEL PRODUCTS — BASE MILL PRICES

	STRUCT. SHAPES—PLATE‡	REINF. BARS billet *be*‡	RIVETS ½-in. structural‡	WIRE NAILS Base *d*‡	SHEET PILING Base‡	STEEL RAILS Per Net Ton: Standard	Light	Re-rolled	TRACK SUPPLIES‡: Angle Bars	Std Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.80	$2.75	$5.65	$4.25/5.00	....	$55.00	$62.00	Not	$3.85	$4.85	$3.65	$7.00
Chicago	2.80	2.75	5.65	4.25/5.00	$3.30	.....	.....	avail-	3.85	4.85	3.65	7.00
Pittsburgh	2.80	2.75	5.65	4.25/5.00	3.30	55.00	62.00	able	3.85	4.85	3.65	7.00
Buffalo	2.80	2.75	....	....	3.30	.....	.....	....	....	....	3.65	....
Cleveland	....	2.75	5.65	.. 4.35	....	.....	.....	....	....	....	....	....
Youngstown	....	2.75	....	....	....	.....	.....	....	....	4.85	....	....
Gulf ports	....	....	....	....	....	.....	.....	....	....	....	....	....
Geneva	2.975‡	....	....	....	....	.....	.....	....	....	....	....	....
Los Angeles	3.41/3.47‡	3.329‡	....	....	....	.....	.....	....	....	....	....	....

‡ Delivered. *b* Rail steel price upon application. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports. On tie plates alone, Steelton, Pa.; on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per CL. *e* Mill lengths. Add 50¢ for cut lengths. *f* Per 100 lbs.

IRON AND STEEL PRODUCTS — F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS *g* Per 100 lb., base price *u*: 5 tons to carload lot *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH *h* Per 100 sq. yd., carload lots: Std. diamond mesh, 3.4 lb	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots: 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires	SHEET PILING Per 100 lb. base price.
Atlanta	$5.12‡	$5.12‡	$5.12‡	$.025	$.10	$31.00	$33.00	$2.58	$1.78	$2.71	....
Baltimore	4.71	3.97*t*	....	....	.10	33.50	35.50	2.41	1.67	2.53	....
Birmingham	4.25	4.40	4.40	.05	.15	40.00*p*	43.00*p*	2.56	1.76	2.68	....
Boston	4.97‡	4.72‡	4.19‡*c*	....	.10/.15	29.00	31.00	2.49	1.72	2.62	$3.8032*k*
Chicago	4.40	3.50*ff*	3.50*ff*	.05	.05	27.00‡	29.00‡	2.26	1.58	2.37	3.30*a*
Cincinnati	4.79‡	3.883*c*	3.883*c*	....	....	29.00*zee*	31.00*zee*	2.40	1.66	2.52	3.708*d*
Cleveland	4.70	3.39*v*	....	....	.10	29.00	31.00	2.36	1.63	2.47	....
Dallas	6.72	5.00	5.00	....	....	32.50	35.00	2.66	1.83	2.79	....
Denver	5.95	5.80*e*	....	....	....	40.00*a*	45.50*qa*	2.69	1.84	2.82	5.89
Detroit	4.82‡	4.73	....	....	.10	33.50*x*	35.50*q*	2.40	1.66	2.52	3.683*qd*
Kansas City	5.35*ee*	4.23*aak*	4.23*aak*	....	.10	34.00	36.00	2.47	1.71	2.59	3.893*k*
Los Angeles	5.15*f*	5.10	....	....	....	39.00*fk*	45.00*fk*	2.76	1.89	2.90	4.78*d*
Minneapolis	4.83‡	5.166*ccn*	5.166*ccn*	...	.15	30.50*k**	32.50*k**	2.47	1.70	2.58	3.864*k*
Montreal	4.90*i*	4.25*i*	4.25*i*	....	....	40.28*h*	42.98*h*	2.54	1.75	2.66	78.70*jdqq*
New Orleans	....	4.64*ok*	....	.05	.10	27.50	29.50	2.54	1.75	2.67	.....
New York	4.78*r*	4.55	....	....	.15/.20	30.60*st*	32.00*st*	2.46	1.69	2.58	3.35*a*
Philadelphia	4.57	4.59	....	....	....	30.00‡	32.00‡	2.42	1.68	2.54	3.77
Pittsburgh	4.40	4.40	4.40	.05	.10	32.50	34.50	2.26	1.58	2.37	3.05
St. Louis	4.73‡	4.458*c*	4.458*c*	....	.05	40.00‡	42.00‡	2.38	1.65	2.49	....
San Francisco	5.20	4.53	....	....	....	32.50	34.50	2.76	1.89	2.90	4.85
Seattle	3.628*s*	4.43*el*	....	....	....	35.00*ss*	38.50*ss*	2.76	1.89	2.90	4.355*dd*

‡ Delivered. *a* Mill prices. *b* 1–5 tons, add 35c. Less than 1 ton, add 50c. *c* 20 tons or over base. *d* Mill price plus freight. *e* F.o.b. plant *f* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15c. differences between new billet and rail steel. *h* List price. Dominion tax exempt. Provincial and Municipal tax extra. *i* Plus Dominion, Provincial and Municipal sales tax. *j* Price per ton. *k* F.o.b. city. *l* Intermediate and hard grade, new billet. *m* Per sq. yd. *n* 5 to 8 tons base. *o* 5 to 15 tons base. *p* Del. of 5000 sq. yd. or less. *q* Std. ribbed. 4 lb. per sq. yd. *r* 5 tons or over. *s* LCL. *t* Asphalt coated. *u* Note: Revised size extra—1 in., 1¼ in., 1½ in. 10¢, ¾ in., ⅞ in. 15¢, ⅝ in. 20¢, ½ in. 35¢, ⅜ in. 55¢, ¼ in. $1.30. *v* Under 20 tons. Straight. *w* Copper bearing. *x* 2.5 lb. per sq. yd. *y* $.0093 transportation tax included. *z* Copper alloy. *aa* 20 tons base. *cc* F.o.b. cars Chic. plus freight. *dd* F.o.b. dock. *ee* F.o.b. cars. *ff* Carload lots. *gg* Including sales tax. * Price in effect since Jan. 20, 1948.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, Delivered ASTM C13–44T: std. 8 in. s.s.	std. 12 in. s.s.	24 in.	36 in.	CLAY DRAIN TILE ASTM C4–24 Per 1,000 ft., carload lots, f.o.b.: 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTMC 14–41 12 in.	24 in.	WROUGHT STEEL PIPE** (Full standard weight, f.o.b. destination *s*) 2½ & 3 in., Butt Weld: Black %	Galv. %	3½ to 6 in., Lap Weld: Black %	Galv. %
Atlanta	$85.84	$0.43	$0.67	$3.39	$7.00	$114.00	$140.00	$0.45	$2.00	47.2	31.2	42.2	25.7
Baltimore	90.02	.378	.729	3.105	8.098	147.00	228.00	.80	2.20	50.9	34.9	45.9	29.4
Birmingham	79.50	.375	.675	3.06	....	210.00‡	375.00‡	.75	2.00	47.2	31.2	42.2	25.7
Boston	93.14	392*uwx*	.756*uwx*	3.465*uwy*	8.7125*uwy*	150.60	233.40	1.03*gcc*	2.75*gcc*	49.2	33.2	44.2	27.7
Chicago	92.17	.54	1.04	4.12	12.80	150.00‡	270.00‡	.65	2.25	53.0*t*	37.0*t*	47.0*t*	30.5
Cincinnati	90.73	.42	.81	....	....	....	....	.60	2.95	51.4	35.4	46.4	29.9*t*
Cleveland	92.74	.336*z*	.648*z*	2.88*z*	8.0975*z*	141.50	221.00	.58	2.25	53.7	37.7	48.7	32.2
Dallas	94.48	.375	.675	2.70	6.20	109.00	131.00	.45	1.45	45.3	29.3	40.3	23.8
Denver	99.32	.40*dd*	.71*dd*	2.98*dd*	....	.....	.....	.74*dd*	2.50*dd*	43.4	27.4	38.2	21.7
Detroit	92.74	.51	.98	4.31	10.79	195.00‡*m*	303.00‡*m*	.50	1.90	51.9	35.9	46.9	30.4
Kansas City	93.82	.39*m*	.705*m*	2.78*m*	7.15*m*	180.00*m*	310.00*m*	.60*l*	1.90*l*	48.7	32.7	43.3	26.8
Los Angeles	105.70	.414	.894	4.347	10.868	220.00‡	360.00‡	.65	...	....	....	....	....
Minneapolis	96.00	.55*mo*	1.05*mo*	4.10*mo*	....	.....	.....	1.19*h*	3.18*h*	48.8	32.8	43.4	26.9
Montreal	78.20	.73*s*	1.28*s*	4.20*s*	6.80*ez*	.60*paa*	.48*paa*	72.00*jkaa*	218.00*jkaa*	....	....	....	....
New Orleans	88.72	.412	.762	3.955	9.15	231.00*bb*	.....	.55	1.95	46.8	30.8	41.8	25.3
New York	89.06	.62	1.14	4.39	11.20	.....	.....	1.00	2.25	50.2	34.2	45.2	28.7
Philadelphia	87.14	.50	.95	3.95	9.75	220.00‡	275.00‡	1.05*h*	2.75*h*	50.7	34.7	45.7	29.2
Pittsburgh	93.22	.364*m*	.702*m*	2.70*m*	6.625*m*	130.20	197.40	1.05*h*	2.50*g*	54.0*t*	37.0*t*	49.0*t*	32.5*t*
St. Louis	90.16	.40	.72	2.88	6.53	.....	.....	1.10*il*	2.30*hl*	50.6	34.6	44.7	28.2
San Francisco	105.70	.438*d*	.878*d*	3.69*d*	9.23*d*	169.00*dl*	282.00*dl*	.69	2.85	....	....	....	....
Seattle	107.50	.45*b*	.81*b*	....	....	72.50*c*	.....	.80*	2.40*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, CL, Burlington, N. J. (base) $84.50. Based on existing freight rates; subject to rate change. Gas pipe and class A, $5 per ton additional. 4 in., $5 per ton additional, 30 in. and larger, usually $1 per ton less. *b* Extra strength ASTM C 200–44T. *c* 4-in. *d* SS361-A. *e* 30 in. *g* Culvert pipe. Reinforced, ASTM C76–41. *h* Reinforced. ASTM C75–41. *i* Reinforced. ASTM C76–37. *j* Centrispun. *k* Per 100 ft. *l* F.o.b. plant. *m* Truck delivery. *o* Listed price is based on LCL (no minimum). *p* Less than 5 ton loads, price per ft. *s* Discounts from standard list consumers carload prices. Base price approx. $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92; 3 percent tax on transportation costs not included. *t* Within switching limits. *u* ASTM C13–40. *v* F.o.b. city *z* 2 ft. lengths. *y* 3 ft. lengths. *z* CESA A60–1941 specifications used. *aa* No standard specifications in Can. *bb* Freight allowed to destinations in city. *cc* Truck loads; f.o.b. plant, Newton. *dd* LCL, delivered, f.o.b. truck. ** Recent 20% emergency freight rate increment granted railroads on Jan. 5 not included. *Correction: Comparable Dec.-Feb. prices were $ 70 (12-in.), $2.00 (24-in.).

WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt weld — 1 in. and 1¼ in. black, 34 galv., 16; 1½ in. black, 38 galv., 18½; 2 in. black, 37½, galv., 18. Lap weld — 2½ in. to 3½ in. black, 31½, galv., 14½; 4½ in. to 8 in. black, 32½, galv., 17. Freight rates to destination to be added to name delivered price.

Buckeye

The Outstanding 3/4 Yard Shovel

*Now Better Than Ever**

Available for spring shipment

* CHECK THESE NEW FEATURES

- 2-piece swing clutch band-velvet smooth operation; easier replacement.
- Heavier revolving frame; more massive conical roller assembly; hardened steel roller path.
- Positive locking device on crawler adjusting bolt.
- Relay valve in dipper trip vacuum chamber speeds dumping.
- 3-cyl. GM 3-71 diesel engine with hydraulic coupling furnishes greater, smoother, more economical power (optional) and others.

and others

Always a "best buy" because it offers *all* of the construction and operating features that most shovel users want—*plus* Mevac (metered vacuum) power control, the Buckeye Clipper is now better than ever. Buckeye engineers and field men constantly sounding out the hundreds of owners have incorporated feature after feature to make it truly "the users shovel".

Operators like Mevac control—light touch on small levers actuates vacuum boosters which operate shovel—easy on the operator, easy on the shovel. Faster action, greater yardage. Cuts maintenance costs too. Nothing to freeze, heat-up or leak. Only Buckeye Clippers have Mevac control.

Send for a copy of the new Buckeye Clipper book—pictures Buckeye on all types of excavating, loading and handling jobs—takes the shovel apart before your eyes—explains Mevac control.

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FINDLAY, OHIO

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Other Products: Buckeye Ditchers, Spreaders, Finegraders----Gar Wood Scrapers, Dozecasters, Tipdozers ---- Gar Wood Hoists, Bodies, Winches, Cranes, Tanks ---- St. Paul Hoists, Bodies, Truck Patrols

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F. O. B.

SHORT LEAF YELLOW PINE AND DOUGLAS FIR

All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)

All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)

	1x6 s4s	1x8 s4s	2x4 s4s	2x6 s4s	2x8 s4s	2x10 s4s	3x12 Rgh	6x12 Rgh	12x12 Rgh
Atlanta	l **$80.00**	**$82.00**	**$70.00**	**$70.00**	**$75.00**	**$76.00**	**$80.00**	.....	.....
	l *95.00*	*95.00*	*96.50*	*96.50*	*96.50*	*96.50*	*87.50*	*$87.50*	*$87.50*
Baltimore	**96.00**	**96.00**	**96.00**	**95.00**	**100.00**	**104.00**	**115.00**	.....	.....
	106.00	*108.00*	*112.30*	*112.00*	*114.00*	*114.00*	*121.00*	*121.00*	*121.00*
Birmingham	l **90.50**	**90.50**	**87.00**	**86.00**	**87.00**	**90.00**	**110.00**	.....	.....
	l *95.50*	*95.50*	*92.00*	*91.00*	*92.00*	*95.00*	*114.00*	*102.00*	*105.00*
Boston	88.00[3]	90.00[3]	88.00[3]	88.00[3]	90.00[3]	93.00[3]	100.00[3]	.....	.....
	95.00	*95.00*	*95.00*	*95.00*	*95.00*	*95.00*	*105.00*	*105.00*	*105.00*
Chicago	‡ **100.00**	**104.00**	**93.00**	**93.00**	**93.00**	**100.00**	**100.00**	.....	.....
	‡ *103.00*	*108.00*	*100.00*	*100.00*	*100.00*	*105.00*	*105.00*	*105.00*	*105.00*
Cincinnati	**100.00**	**100.00**	**95.00**	**95.00**	**95.00**	**95.00**	**130.00**	.....	.....
Cleveland	**92.95**	**92.95**	**82.89**	**82/89**	**82/89**	**87/94**	.....	.....	.....
Dallas	l **71.00**	**71.00**	**61.00**	**59.00**	**61.00**	**66.00**	**80.00**	.....	.....
Denver	*101.00*	*100.00*	*97.00*	*94.50*	*94.00*	*95.50*	*97.00*	*104.50*	*105.50*
Detroit	b **98.00**	**98.00**	**90.00**	**90.00**	**95.00**	**93.00**	**93.00**	.....	.....
	b *98.00*	*98.00*	*92.00*	*92.00*	*93.00*	*95.00*	*100.00*	*100.00*	*105.00*
Kansas City	b **105.00**	**110.00**	**100.00**	**100.00**	**100.00**	**105.00**	.....	.....	.....
	b *105.00*	*110.00*	*100.00*	*100.00*	*100.00*	*105.00*	*110.00*	*125.00*	*125.00*
Los Angeles	a *103.00*	*103.00*	*103.00*	*103.00*	*103.00*	*103.00*	*107.00*	*117.00*	*107.00*
Minneapolis	‡b 112.00[6]	112.00[6]	.....	.....	.....	.....	.....	.....	.....
	‡b *108.00*	*108.00*	*108.00*	*108.00*	*108.00*	*110.00*	*130.00*	*130.00*	*130.00*
Montreal	e[3] 73.00	76.00	70.00	72.00	76.00	85.00	.....	.....	.....
	111.55	*111.55*	*111.55*	*111.55*	*111.55*	*111.55*	*120.00*	*87.00*	.....
New Orleans	l **80.00**	**90.00**	**75.00**	**80.00**	**80.00**	**77.00**	**85.00**	.....	.....
	l *68.00*	*68.00*	*70.00*	*67.00*	*67.00*	*67.00*	*71.00*	*67.00*	*72.00*
New York	‡ **100/105**	**100/105**	**Range from $90.00 to $95.00**				**110/115**	.....	.....
	‡	.....	*Range from $110.00 to $115.00*				*115/120*	*115/120*	*115/120*
Philadelphia			**Range from $100.00 to $110.00**				**100/110**	.....	.....
			Range from $110.00 to $120.00				*110/120*	*110/120*	*110/120*
Pittsburgh	l **75.00**	**77.00**	**80.10**	**80.10**	**85.25**	**89.70**	**107.75**	.....	.....
	l *93.60*	*93.60*	*83.00*	*83.00*	*87.00*	*91.00*	*110.00*	*116.00*	*118.00*
St. Louis	‡j **110.00**	**110.00**	**110.00**	**107.00**	**110.00**	**113.00**	.....	.....	.....
	‡j *110.00*	*110.00*	*117.00*	*119.00*	*119.00*	*120.00*	*130.00*	*130.00*	*130.00*
San Francisco	d *76.50*	*76.50*	*76.50*	*76.50*	*76.50*	*74.50*	*74.00*	*74.00*	*74.00*
Seattle	l *70.00i*	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*75.00i*	*75.00i*	*75.00i*

	LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment* (See note for base price)	
	2x12 Rgh	12x12 Rgh	5/8"	3/4"
Atlanta	.....	.....	$22.32	$27.24
	.....	.....	.....	.....
Baltimore	193.60	182.00	22.86	27.90
	.....	.....	.....	.....
Birmingham	120.00	117.50	21.78	26.58
	.....	.....	.....	.....
Boston	.....	.....	22.86	27.90
	105.00	105.00	.....	.....
Chicago	125.00	125.00	18.72	22.80
	.....	.....	.....	.....
Cincinnati	120.00	.....	21.78	26.58
Cleveland	.....	.....	22.20	27.12
Dallas	72.00	80.00	18.72	22.80
Denver	.....	.....	13.92	16.98
Detroit	90.00	105.00	21.78	26.58
	.....	.....	.....	.....
Kansas City	.....	.....	16.56	20.16
	.....	.....	.....	.....
Los Angeles	.....	.....	13.38g,h	16.26g,h
Minneapolis	.....	.....	16.56	20.16
	.....	.....	.....	.....
Montreal	.....	.....	.....	.....
	.....	.....	.....	.....
New Orleans	100.00	105.00	18.72	22.80
	.....	.....	.....	.....
New York	175/200†	175/200†	22.86	27.90
	.....	.....	.....	.....
Philadelphia	150.00	150.00	22.86	27.90
	.....	.....	.....	.....
Pittsburgh	130.20	141.00	22.56	27.48
	.....	.....	.....	.....
St. Louis	.....	.....	18.72	22.80
	.....	.....	.....	.....
San Francisco	.....	.....	10.08g	12.30g
Seattle	.....	.....	.....	.....

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [3] Spruce. [6] Western Pine, No. 3 Common. [3] Norway Pine. ‡Delivered. *a* Yard prices. *b* Retail prices, less than CL. *c* 5 M ft. or less. *d* Direct mill prices; f.o.b. purchasers carrier or truck. *e* Tax exempt. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* No. 1 common. *j* Delivered in 5000 ft. lots. *k* These are retail yard prices quoted per truck load in Greater Cleveland. Less 2% for cash. Truck lots. *l* F.o.b. mill.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq ft. surface. Seattle base price on ¼", $174.00; on ½", $200.00. For other centers add rail freight increment from table on proper size. For oiling add $3.00; for edge sealing add $2.00; for resin sealing add $8.50.

* Freight rates include 20% emergency increase granted railroads on Jan. 5.

† 18 ft. and under.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS Discounts from jobbers list, Jan. 16, 1946 Single or Double Thickness A quality	B quality	EXPLOSIVES Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*	
Atlanta	76%	76%	$0.195	
Baltimore	70–10%	71–10%	.195	
Birmingham	68%	68%	.15	
Boston	77%	78%	.195	
Chicago	68%*e*	68%*e*	.195	
Cincinnati	67–6%*g*	67–6%*g*	.195	
Cleveland	67–10–10%	67–10–10–10%	.235	
Dallas	67%*e*	68%*e*	.2075	
Denver	68%	68%	.20	
Detroit	67-10-10%	67–10–10%	.195	
Kansas City	68-10%*g*	68-10%*g*	.20	
Los Angeles	62%	67%*h*	.2025	
Minneapolis	68%	68%	.20	
Montreal	40–5%*ab*	40–10–5%*ab*	18.25*i*	
New Orleans	68%	68%*e*	.205	
New York	73%	74%	.265*f*	
Philadelphia	69%	70%	.195	
Pittsburgh	70–10%	70–10%	.1675	
St. Louis	70–10%	70–10%	.20	
San Francisco	66%	73%	.20	
Seattle	57%	58%	.2025	

Price of 60% Ammonia Gelatin is $0.0125 per lb. higher than 40%

a Discount from list, Sept., 1939; all now tax exempt. *b* Single thickness. *e* Discount from list of Jan. 29, 1947. *f* In borough of Kings, Queens and Richmond, and in Manhattan south of Canal St., add delivery charge of $9.00 per trip. *g* Discount from list of Aug 15, 1938. *h* Single thickness. Double thickness, 66%. *i* F.o.b. city per 100 lb. forcite, 40%; 60%, $20.00.

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.15	$0.175	$0.195
W. of Miss. to Rocky Mtn. States. Fla. and Maine.	.155 –.1625	.18 –.1925	.20 –.2125
Rocky Mtn. States	.155 –.1675	.18 –.1975	.20 –.2175
Pacific N. W. States	.1525–.165	.1825–.195	.2025–.215
Pacific S. W. States	.15 –.1575	.18 –.1875	.20 – .21

PILES, TIES F. O. B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail Pine*	By Rail Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	....
12-in.— 2-ft. from butt	6-in.	50 to 59-ft.	.35	....
12-in.— 2-ft. from butt	6-in.	60 to 69-ft.	.36	....
12-in.— 2-ft. from butt	6-in.	90 to 100-ft.	....	.62
13-in.— 3-ft. from butt	5-in.	91 to 100-ft.	....	.63
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.41	.70
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.43	.64
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.54	.65
14-in.— 2-ft. from butt	5-in.	85 to 89-ft.	.57	.66
14-in.— 2-ft. from butt	5-in.	90 to 100-ft.	....	.70

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

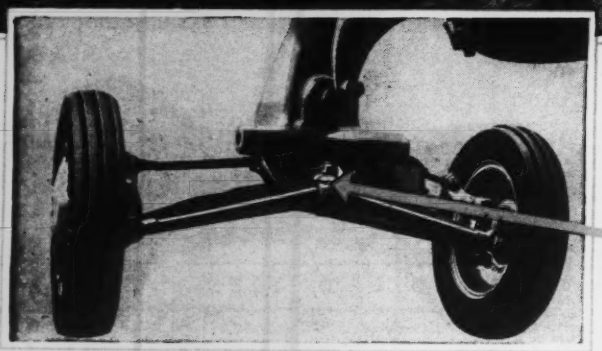
Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.45	.....	$2.00	.....
	Pine	1.35	$3.05*a*	1.90	$4.00*a*
New York	S. L. Sap Pine	1.65	2.85	2.00	3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.35/2.45*a*	....	3.25/3.40*a*
Los Angeles	Douglas Fir	1.86	2.82*a*	....	....
Philadelphia	Red Oak	2.33	3.13*a*	3.10	4.25*a*
St. Louis	White Oak	1.75	....	2.45	....
	Red Oak	1.70	2.35*a*	2.40	3.40*a*
	Sap Pine or Cypress	2.20*a*	....	....	....
San Francisco	Douglas Fir	1.60*ef*	2.80*f*	2.10*bf*	3.88*caf*
Montreal	Birch or Maple	....*h*	....*h*	....*h*	....*h*

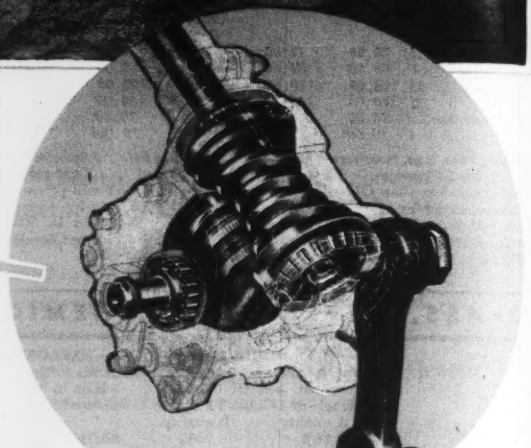
Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 7" x 9" x 8'. *c* Empty cell. *e* Green. *f* F.o.b. cars. *h* No constant price available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100 lb	$3.75
Chlorine cylinders, liquid, per lb. f.o.b. works	.07–.12
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, f.o.b. works, ton	22.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.65
Soda ash, 58%, in paper bags, per 100 lb. dense	1.38
Sulphate of aluminum, commercial, in 100-lb. bags f.o.b. works	1.15–1.30
Sulphate of copper, in bags, per 100 lb f.o.b. works	7.60





GEMMER EASY STEERING

Allis-Chalmers Co. chose Gemmer Easy Steering for this hard working AD Motor Grader because steering has to be right in such a vehicle.

The Gemmer worm and roller tooth principle makes the AD Motor Grader steer easily—as it has motor vehicles of all types. Gemmer pioneered easy steering in the automotive industry.

Gemmer Steering Gears are compact, sturdy, simple. They rarely need adjustment, and with reasonable care will last the life of the vehicle.

Gemmer Steering is always firm, responsive, positive, with absence of rubbery feeling or wander.

Helps the AD *Motor Grader* Do Tough Jobs Easily

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GEMMER MANUFACTURING COMPANY

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STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME — DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M. lots of 2,000 pieces or over.			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over.			BRICK Per M. in quantity		LIME Per ton. In paper. Carload lot.		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Hydrated finishing	Common hydrated	Pulverized, or lump
Atlanta	.....	.....	.....	.....	.....	.....	$24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	$120.00	$126.00	$220.00	$240.00	$315.00	$340.00	31.00*k*	33.00*k*	30.00	18.00	.....
Birmingham	97.50	104.00	195.00	231.00	.....	.....	20.00*ff*	22.50*gg*	24.67	18.10	.....
Boston	105.00†	112.00†	210.00†	252.09†	.....	.....	20.00*s*	20.00*s*	21.00†	.....	16.00
Chicago	115.00	122.50	230.00	.....	.....	.....	20.00	21.00	25.00	18.00	.....
Cincinnati	155.00*j*	165.00*j*	220.00*jdd*	.....	.....	.....	33.00*j*	33.00*j*	22.00*j*	20.25*j*	.....
Cleveland	113.50*cc*	121.00*cc*	222.50*cc*	.....	.....	.....	27.50	27.50	21.45	19.45	23.55*es*
Dallas	.....	106.00	.....	.....	.....	.....	18.00	20.00	28.00	22.00	.....
Denver	.....	.....	.....	.....	.....	.....	28.50	28.50	34.80*bb*	28.00*bb*	34.00*bb*
Detroit	130.00	145.00	260.00	300.00	380.00	443.00	28.00*cc*	30.00*cc*	28.00	26.00	26.00
Kansas City	112.00	120.00	.....	.....	.....	.....	16.00*o*	18.50*o*	36.00*p*	30.00*p*	30.00*p*
Los Angeles	*r*	*r*	*r*	*r*	*r*	*r*	20.00§	.....	33.20	33.20	27.00
Minneapolis	162.10*p*	187.00*p*	334.30*p*	187.00*wp*	.....	.....	27.00*ep*	.....	33.50*bbe*	24.50*bbe*	33.50*bbde*
Montreal	100.00*aq*	110.00*aq*	206.25*aq*	151.50*aqq*	.....	294.40*aq*	24.00	34.50	12.50*ub*	14.00*ub*	18.45*u*
New Orleans	160.00	160.00	300.00	.....	.....	.....	29.00	.....	30.00	20.00	.....
New York	103.90*	110.80*	1 52.35*c**	166.70*hn**	.....	.....	29.00	.....	34.00	25.90	.....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	26.00	29.00	29.75	17.50	24.50
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	26.00	31.00*y*	20.45	18.65	2.97*m*
St. Louis	118.50	122.00	225.00	235.00	305.00	.....	28.50*al*	26.50*al*	.72*saap*	.55*saap*	82*aaspse*
San Francisco	124.00*a*	139.50*a*	186.00*dda*	139.50*a*	.....	.....	27.50	.....	24.85	24.85	2.48*m*
Seattle	137.00*cc*	147.00*cc*	.....	147.00*ccw*	.....	.....	28.50	33.50	32.00*shh*	32.00*shh*	3.60*mhh*

† F.o.b. *a* Smooth. *b* Per 50 lb. bags. *c* 6 x 12 x 12 in.-3 cell. *d* Pulverized hot. *e* 5% discount for cash. *g* 5½ x 8 x 12. *h* F.o.b. trucks, job site N.Y.C. *i* F.o.b. warehouse only. *j* Truck load or over. *k* $1.00 discount. *l* Red face. *m* Per bbl., 180 lb. *n* 7¾ x 7¾ x 12. Speed title. *o* F.o.b. Buffalo. *p* Truck lots. *q* Provincial and Municipal tax extra. *r* Not used because of earthquake danger. *s* 2% discount for cash. *t* 5¼ x 8 x 11¼. *u* Tax exempt. *v* Sand lime. *w* 5 x 8 x 12. *y* Stacked. *z* Pebble lime price per 80 lb. sack. *aa* Price per sack. Lime not sold per ton. *bb* LCL. *cc* Truck delivery. *dd* 6 x 12 x 12. *ee* Pebble lime. *ff* 80% common. *gg* Select. *hh* LCL. § F.o.b. plant. *No definite price available. Above prices subject to an escalator clause.

PAINT, ROOFING — F. O. B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl.	WHITE LEAD Per 100 lb. in 100 lb. cases	READY-MIXED PAINT Per gal., drums			ROOFING SUPPLIES Carload lots f.o.b. factory			
	Dry *a*	In oil *w*	Graphite *b*	Aluminum *c*	Ferric Oxide *d*	Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$18.85	$27.375	$1.75	$2.70	$1.65	$2.06‡	$2.06‡	$2.06‡	$1.00‡	$36.00‡
Baltimore	18.60	27.00	2.25	3.50	2.75	2.75	3.30	3.30	.55	33.00
Birmingham	18.85	27.375	4.40	4.52	....	3.05	3.00	3.00	.48	42.00*ee*
Boston	18.60	27.00	1.75	2.50	2.31	2.00‡*h*	3.30‡*q*	3.30‡*q*	.25‡	21.00
Chicago	18.60	27.00	....	....	....	2.78‡*u*	2.91‡*o*	2.91‡*o*	34.00‡*bbe*	35.00‡
Cincinnati	18.60	27.00	....	....	....	2.39	2.50*o*	2.50*o*	.35*y*	40.00
Cleveland	18.60	27.00	3.00	3.00*s*	3.00	2.39	2.50*o*	2.50*o*	.32*y*	35.40
Dallas	18.60	27.00	....	4.05	....	2.69*q*	3.00*q*	3.15*q*	.90	45.00
Denver	18.60	27.50	2.88	4.38	2.63	3.17*o*	3.09*o*	.....	.46*ff*	.....
Detroit	18.60	27.00	2.25	3.00	2.00	2.27	2.38	2.38	.50	33.00
Kansas City	18.60	27.125	3.30*g*	3.55*g*	3.16*g*	3.00	3.25	3.50	.54	31.00
Los Angeles	18.85	27.50	2.80	4.00	3.50	2.32	1.77*e*	*l*	65	*l*
Minneapolis	18.60	26.88*m*	....	....	....	2.27*idd*	2.38*hidd*	2.38*hidd*	.42*idd*	33.00*rdd*
Montreal	.....	19.20	2.90*p*	4.20*p*	3.62*p*	3.14*t*	2.85*tf*	2.30*tf*	.68*t*	2.15*kt*
New York	18.60	27.00	3.45*y*	....	3.45*y*	2.28	2.3*so*	2.38*o*	.34*s*	33.00
Philadelphia	18.60	27.00	3.25	3.65	3.15	2.54	2.94	2.94	.37	26.00
Pittsburgh	18.60	27.00	2.00	2.90	1.90	2.93	3.00*o*	3.00*o*	.37	38.00
St. Louis	18.60	27.00	....	....	....	2.90	2.90	2.90	.44	34.00
San Francisco	18.85	27.25	1.80	2.75*n*	1.35	2.27*x*	3.30*aa*	....	.38*q*	.....
Seattle	18.85	27.50	2.95*m*	2.95*m*	....	3.25*mqcc*	3.35*hmcc*	....	.49*mcc*	46.75*jmcc*

‡ Delivered Note: Red lead in oil 50c higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* 15 lb. *f* Per 432 sq. ft. *g* 50 gal. drums. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per cwt. *l* Not used. *m* 1% discount for cash. *n* May, 1941 price. *o* Per 60-lb. roll. *p* Tax included. *q* Per 90-lb. roll. *r* F.o.b. factory Chicago. *s* ASTM Spec. D266-41. *t* Federal tax included. *u* Per 90 lb. square. *v* Per ton. *w* Price to large paint contractors is $1.25 less. *x* Mineral surfaced. *y* 55-gallon container. *z* Drums. *aa* Approximate cost per 100 lbs. *bb* Roofers coating and cement. Price per ton. *cc* LCL. truck delivery. *dd* 2% cash discount. *ee* Asphalt in 100 lb. package. *ff* 5-gal. drums.

SKILLED AND COMMON WAGE RATES — PER HOUR

	Brick-layers	Car-penters	Struct. Iron Workers	Hoisting Engineers	Plas-terers	Electrical Workers	Steam-fitters	Common Labor Building	Common Labor Heavy Const.
Atlanta	$2.25	$1.65	$2.00	$2.00	$2.00	$2.00	$2.00	$0.75	$0.85
Baltimore	2.50	1.95	2.15	2.20/2.40	2.00	2.00	2.00	1.10	1.10
Birmingham	2.25	1.625	1.90	1.60/1.875	2.00	2.00	2.25	.85	.95
Boston	2.15	1.90	2.15	2.25	2.25	2.15	2.00	1.40	1.40
Chicago	2.20	2.15	2.20	2.15	2.225	2.35	2.35	1.50	1.50
Cincinnati	2.25	1.975	2.10	2.00	2.125	2.125	2.125	1.25	1.15
Cleveland	2.375	2.125	2.375	2.25	2.375	2.125	2.375	1.725	1.40
Dallas	2.25	1.875	2.00	2.00	2.125	2.00	2.125	.95	.95/1.50
Denver	2.25*b*	1.875	1.875*b*	1.875*b*	2.25	2.05	2.05	1.275	1.35
Detroit	2.25	2.025	2.25	2.25	2.25	2.25	2.165	1.425	1.425
Kansas City	2.25	1.90	2.05	1.90/2.125	2.25	2.15	2.125	1.35	1.40
Los Angeles	2.375	1.90	2.10	1.85	2.25	2.25	2.25	1.35	1.35
Minneapolis	2.075	1.80	2.00	1.85	2.25	2.06	2.00	1.30	1.30
New Orleans	2.05	1.70	2.00	1.625/1.875	1.875	2.00	2.05	.90	.90
New York	2.75*b*	2.75*b*	3.00	3.00	3.00*a*	2.50*a*	2.75*b*	1.50	1.50
Philadelphia	2.40/2.50	2.00	2.40	2.25	2.25	2.25	2.25	1.10	1.10
Pittsburgh	2.50	2.25	2.25	2.40	2.25	2.25	2.25	1.30	1.30
St. Louis	2.50	2.20	2.25	2.40	2.25	2.25	2.25	1.35	1.75
San Francisco	2.8125	2.00	2.25	2.00	2.25	2.25	2.25	1.40	1.40
Seattle	2.365	2.065	2.265	2.20	2.365	2.265	2.34	1.665	1.70
Montreal*	1.40	1.06	1.11	1.00	1.17	1.11	1.11	.73	.67

a 6 hr. day. *b* 7 hr. day. * Cost of living bonus now included in basic wage.

MEXICO CITY PRICES

In Pesos, F.o.b. City		Feb. '48	Mar. '48
Common Wages—Building (8 hr. day)	av. per hr.	.57	.57
Common Wages—Heavy Const. (8 hr. day)	av. per hr.	.75	.75
Skilled Labor Wages			
Carpenters (8 hr. day)	av. per hr.	1.25	1.25
Bricklayers (8 hr. day)	av. per hr.	1.25	1.25
Struct. Iron Workers (8 hr. day)	av. per hr.	1.50	1.50
Struct. Steel Shapes 3"-15" x 12 meters	per ton	800.00	800.00
Reinf. Steel, Corr. Rods ⅜" x 12 meters	per ton	1,000.00	1,000.00
½" x 12 meters	per ton	975.00	975.00
⅝" x 12 meters	per ton	940.00	940.00
¾" x 12 meters	per ton	940.00	940.00
⅞" x 12 meters	per ton	930.00	930.00
1" x 12 meters	per ton	925.00	925.00
Gravel, truck load of 3½ cu. meters			
Blue Gravel	per tr. load	32.00	32.00
Rose Gravel	per tr. load	28.00	28.00
Cement, Std. Port. (Tolteca)	per ton	115.00	115.00
Lumber			
Mex. Sacred Fir (Oyamel)	per M ft.	400.00	400.00
1st Class Pine	per M ft.	750.00	750.00
2nd Class Pine	per M ft.	500.00	550.00

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $2.169. **ENR Common Average:** $1.287

MOVE YARDAGE FAST at LOW COST!

WITH A

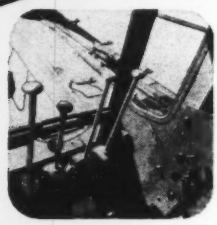
MARION 33-M

¾ YD. SHOVEL

The MARION 33-M is designed and built to meet a vital need for a heavy duty ¾ yard machine that is FAST . . . VERSATILE . . . POWERFUL . . . one that will pile up yardage in "nothing flat". The MARION 33-M has many important and modern features that appeal to the contractor. It is sturdily built—easy to operate—easy to maintain due to readily accessible machinery—and is easy to convert from shovel to dragline, clamshell, crane or pull shovel. Write for Bulletin 395. It will give you many reasons why a MARION 33-M should be working for you.

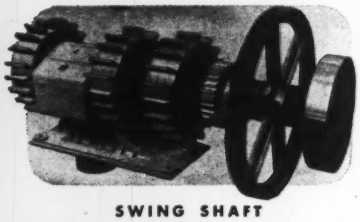
IMPORTANT

MARION 33-M *Features*



AIR CONTROL

Every movement is air operated. Simple . . . foolproof . . . full engine power applied gradually and smoothly to maximum pressure.

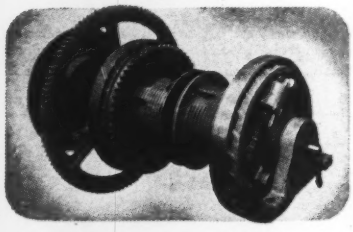


SWING SHAFT

Requires no adjustment at any time. Heat-dissipating fins assure cool running clutches.

INDEPENDENT BOOM HOIST

High speed raising and lowering of boom independent of all other operations.



HOIST DRUM SHAFT

Anti-friction bearings throughout for free-running and lower maintenance.

From ¾ Cu. Yd. POWER SHOVEL COMPANY MARION SINCE 1884 To 40 Cu. Yds.

MARION

POWER SHOVEL COMPANY

MARION, OHIO, U. S. A.

Offices and Warehouses in all Principal Cities • Established 1884

needed to produce • distribute control and utilize... Electric Energy

Westinghouse can Supply

HEATING AND VENTILATING EQUIPMENT

Air Conditioning Equipment

Forced Fans

Fly Ash Control

Compressors

Fume Exhaust Systems

Speed Heaters

Air Blenders

Roof Vane Ventilators

Unit Heaters

Precipitron*

Unitaires

Industrial Heating

Induced Fans

Ventilating Fans

Stokers

LIGHTING EQUIPMENT

Office Lighting Equipment

Vapor-tight and Dust-tight Luminaires

High Bay Luminaires

Industrial Lighting Equipment

Silvered Bowl Diffusers

Lamps

*Reg. U.S. Trademark

Electrical equipment requirements for different types of projects vary widely, of course. But whether it's a commercial building, industrial plant, residential or municipal projects ... you can place undivided responsibility for everything electrical with Westinghouse and its distributor organization.

The advantages of this unit responsibility are obvious:

1. **Specialized Engineering** ... to assist in selecting and applying equipment for maximum efficiency.
2. **Simplified Ordering** ... by providing a focal point of contact for all buying and specification data.
3. **Speedier Installation** ... by centralizing responsibility for delivery and installation.
4. **Better, More Reliable Service** ... through the coordinated design and construction of Westinghouse equipment, plus broad experience in applying it for all types of industries. Westinghouse also offers unmatched electrical maintenance service, through its nationwide chain of Renewal Parts Warehouses and Manufacturing and Repair Shops.

No other electrical organization in the world can match the breadth of these facilities and products for the construction industry. Your near-by Westinghouse office or Westinghouse Distributor is headquarters for this service. Westinghouse Electric Corporation, P. O. Box 868A, Pittsburgh 30, Penna.

J-94763

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Architect's and Engineer's Data Book—B-2161-D
This 362-page book contains data on all Westinghouse products for the building industry. Its format is adapted to the needs of the architect and engineer.

Sweet's Architectural Catalog
In this "bible" of the building industry, Westinghouse is represented in the Architects' File, Engineers' File, Builders' File, Mechanical Industries' File, Process Industry File and Product Designers' File.

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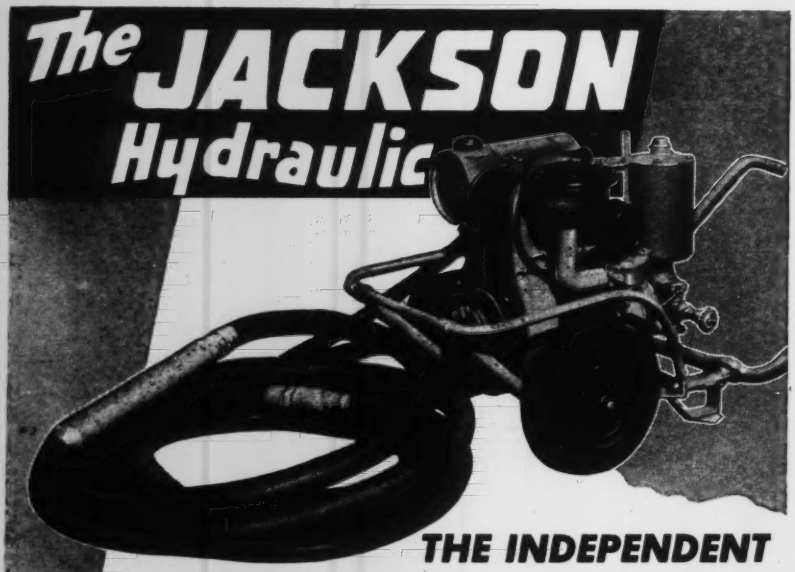
Lighting Equipment Catalog
Contains complete product data and specifications on all types of lighting equipment for commercial, industrial and residential use.

Westinghouse

...TS IN 25 CITIES ... OFFICES EVERYWHERE

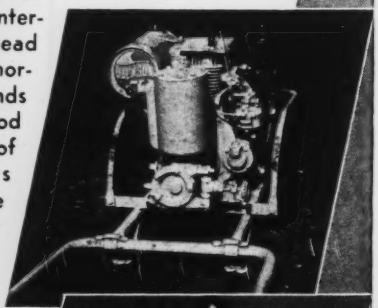
The JACKSON Hydraulic



THE INDEPENDENT CONCRETE VIBRATORY UNIT

Contractors SWEAR BY (Never at)!

For downright reliability and trouble-free service, as well as the ability to do a perfect job of vibrating concrete on a wide range of construction, the JACKSON HYDRAULIC is tops. There are no troublesome parts to break, and as all moving parts run in oil there is no lubrication problem. Amplitude and frequency, the factors so important to proper vibration of concrete, have been correctly balanced with careful regard to the diameter of the vibrator head. Frequency is adjustable from 4000 to 7000 V.P.M. through throttle of the highly dependable 5 H.P. Wisconsin engine. 34 ft. flexible handle gives a satisfactory operating range for all jobs. Wheelbarrow mounting makes the entire assembly easily portable. An interchangeable grinding and drilling head is available and easily attached. Thoroughly proved in the hands of thousands of contractors, this machine has stood the test of time and represents one of the very best equipment investments any general contractor can make. Write for the complete facts or see your JACKSON distributor.



FOR EACH AND EVERY TYPE OF CONCRETE CONSTRUCTION the JACKSON line contains a vibrator that will give you the best possible job at the minimum of labor and maintenance cost — electric, engine-driven flexible shaft and Hydraulic models; internal and external types. Drop us a line for the best solution to any vibrating problem.

ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON MICHIGAN

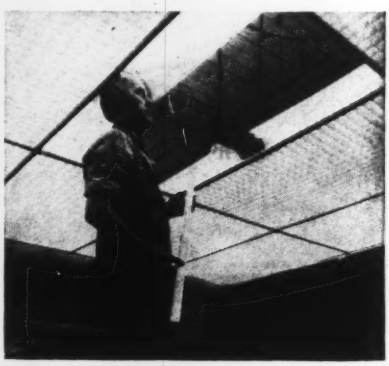
251

JOINT SEAL MELTER—Designed for use with Sealz, rubber compound that permanently seals joints in concrete Sealtz-Melter is of double boiler type, one chamber inside other. Oil heated to 450 deg. F. and automatically controlled at that temperature circulates in outer chamber. This principle prevents overheating and damaging compound,

which is loaded into inner chamber. It holds three 50-lb. bags of material. Heat is supplied by burning gas from pressure cylinders. Melted Sealz is withdrawn through fully insulated valve seated in oil bath chamber. Melter weighs 1150 lb. and is 3½ ft. high, 3 ft. 7 in. long and 27 in. wide.—*U.S. Rubber Co., Rockefeller Center, New York, N. Y.*

252

GLOWING CEILINGS—The entire ceiling becomes a lighting unit with this new fluorescent lighting system as the transparent plastic louvers not only



reflect 18 percent of the light striking its surface but also allow 71 percent transmission.—*Benjamin Electric Mfg. Co., Des Plaines, Ill.*

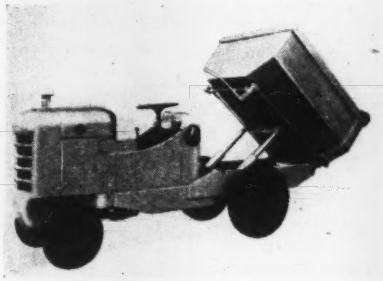
253

TOP SUCTION SUMP PUMP—Designed to overcome one of the most common causes of pump failure—break-

ing of the pump shaft seal because of water pressure—a new sump pump has been announced. Because of top suction the oil seal is subjected only to static pressure from depth of immersion when the pump is not in operation, and when the pump operates water cannot reach the oil seal on air motor. A built-in oiler lubricates all moving parts of the pump—one quart of oil for 24 hours normal operation.—*Gardner-Denver Co., Quincy, Ill.*

254

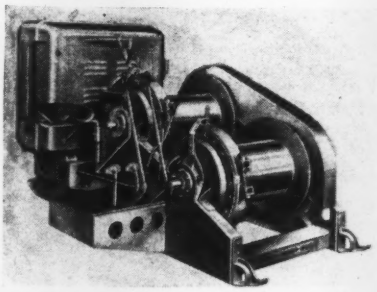
LOAD BUGGY—A new addition to the family of material handling equipment is the "Payloader Buggy," a gasoline engine-driven 4-wheel, pneumatic-tire hauling unit with a 2-cu.yd. capacity hydraulically-dumped body. Low-slung and compact, with a short wheelbase and rear wheel steering to



permit operation in congested areas, the buggy has large wheels with ground gripping pneumatic tires to permit operation on paved or unpaved surfaces, is equipped with hydraulic brakes, and can travel at comparatively high speeds with complete safety.—*The Frank G. Hough Co., 706 Sunnyside Ave., Libertyville, Ill.*

255

HYDRO-HOISTS — New line of 2-speed, hydraulically controlled hoists. Two-speed transmissions and hydraulic finger tip controlled. Offered in two models the Utility with one or two drums and 25 to 40 hp., and the



Erectors model of 60 to 100 hp. with one, two or three drums. Automotive type transmissions driving the drums offer operator instant choice of low gear for slow line speeds in heavy hoisting or high gear for high line speeds

HELTZEL BINS

When you think of bins you think of Heltzel Bins. That's natural because your experience and the testimony of all bin users have proved that Heltzel's concentrated engineering in concrete equipment has brought about practical developments that pay off in durability, versatility and trouble-free operation. We're proud of the demand for Heltzel bins and batchers and we're sorry we can't ship orders at a normal rate. We're doing the best material supply will permit. We know you want the best and will be patient and make your old equipment do until you can install a Heltzel.

Heltzel
BUILDS IT BETTER

- BINS, Portable and Stationary
- CEMENT BINS, Portable and Stationary
- CENTRAL MIXING PLANTS
- BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
- ROAD FORMS (with lip curb and integral curb attachments)
- CURB FORMS
- CURB AND GUTTER FORMS
- SIDEWALK FORMS
- CONCRETE BUCKETS
- TOOL BOXES
- FINISHING TOOLS FOR CONCRETE ROADS

HELTZEL STEEL FORM & IRON CO.
WARREN, OHIO · U. S. A.

They're Protection . . . They're Savings . . .
They Should Be A Part Of Every Business!

Industrial and commercial fire safety has been and must continue to be an important function of business, not only in New England, but everywhere. With modern methods of protection, loss of life or cessation of manufacturing and selling operations because of fire is inexcusable.

Automatic Sprinkler systems have past proved their fire combatability. They stand ready at all times to give instant, effective action at the first indication of flame. Because of this speed of detection, fires in sprinklered properties are usually extinguished in their infancy with but few sprinklers in actual operation, hence, little or no water damage.

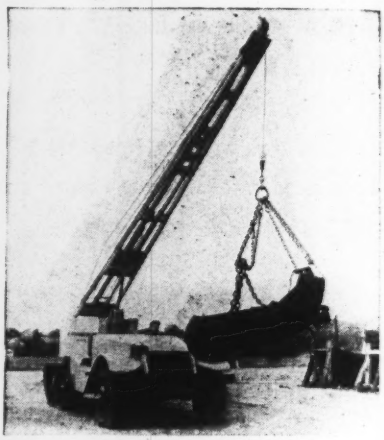
While the element of protection must always be considered of primary importance, approved *Automatic Sprinkler* installations realize at once a savings of upward to 90% in insurance premiums . . . concrete evidence that continues to make *Automatic Sprinklers* an important investment today . . . perhaps welcomed protection tomorrow.

"Automatic" Sprinkler
FIRST IN FIRE PROTECTION
DEVELOPMENT · ENGINEERING MANUFACTURE · INSTALLATION
"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO
OFFICES IN PRINCIPAL CITIES OF NORTH and SOUTH AMERICA

when handling light loads. Hydraulic control of clutching or braking is similar to that on large cranes and power shovels.—*Jaeger Machine Co., Columbus* 16, *Ohio.*

256

LUGGER CRANE—Mobile hydraulic unit to lift and carry up to 6,000 lb. Vertical movement travel of 10 ft. is provided, with corresponding cable travel of 16 ft. Maximum clearance under hook is 18 ft. 6 in. All move-



ments of crane controlled by one man from driver's seat through system of precision hydraulics. Half-track chassis is adapted to any kind of terrain and operates at speeds up to 40 mph.—*Day-Smith Hydraulic Crane Corp., Camp Hill, Pa.*

257

ELECTRIC ERASER—A 12-ounce electric eraser shaped to fit the hand is valuable in the drafting room, as sharp, keen, neat and rapid erasures can be made by this handy device.—*Chicago Wheel & Mfg. Co.*, 1101 *West Monroe St., Chicago* 7, *Ill.*

258

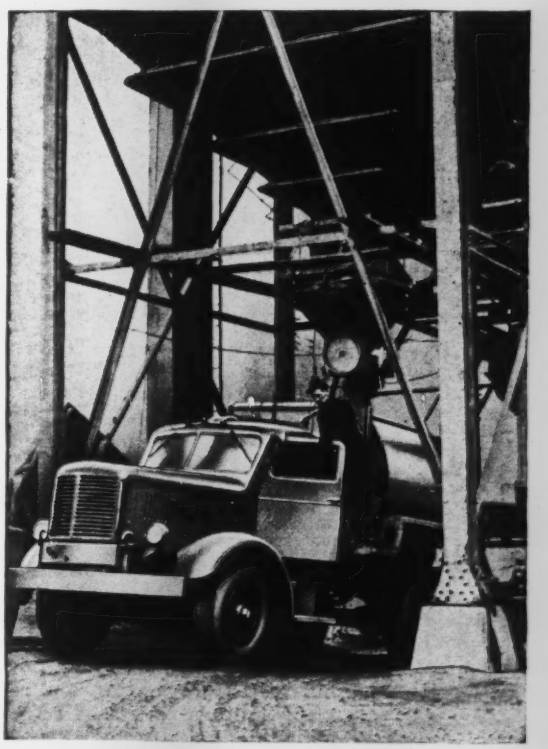
POWERFUL MOTOR GRADER—New 100 hp. No. 610 is largest, heaviest and most powerful grader ever introduced by Adams organization. Powered by 100 hp. International diesel engine. Weighs more than 25,000 lb. without accessories. Ample traction is provided by 18,000 lb. weight on rear wheels. Power steering plus push-button cab controlled electrical starting are furnished as standard equipment. Machine has full-floating rear axle, a 12-ft blade, 31 in. wide, 8 forward speeds, ranging from 2.6 to 25.2 m.p.h. Hydraulic brakes on all four tandem drive wheels.—*J. D. Adams Mfg. Co., Indianapolis, Ind.*

SPEED YOUR CONCRETE MIXING AND HAULING GET MORE WORK DONE WITH FWD TRUCKS

Keeping mixers on the move between central mixing plants and pouring points, speeds operations — makes more money for you. So does a mixer that has FWD four-wheel-drive power and traction to maneuver fast and safely on the job — even when it's off the road, over rough ground of construction sites.

Mount your mixers on FWD four-wheel-drive trucks and you have what it takes to keep going — up and over steep grades, through loose sand or sticky gumbo, over rough and rocky ground, working on or off the road. You speed all operations — you get more work done, more profitably — with mixers mounted on FWDs.

See your nearest FWD Distributor or write for complete information.



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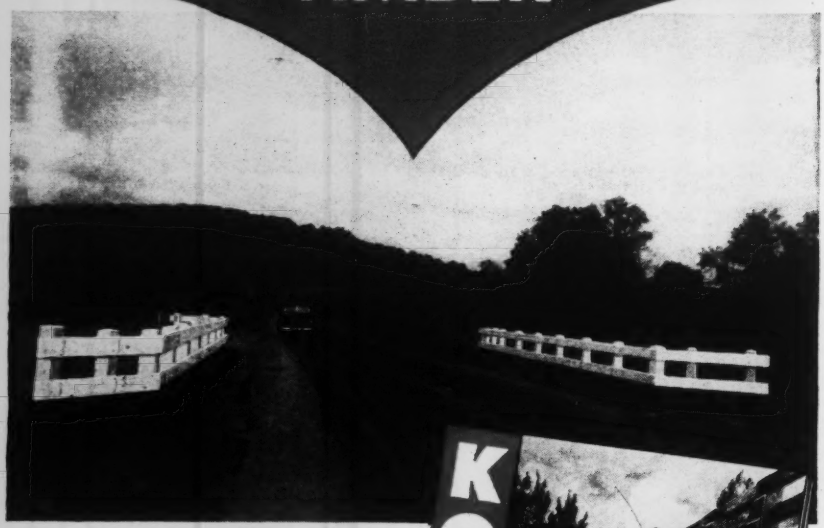
WORLD-WIDE SALES and SERVICE

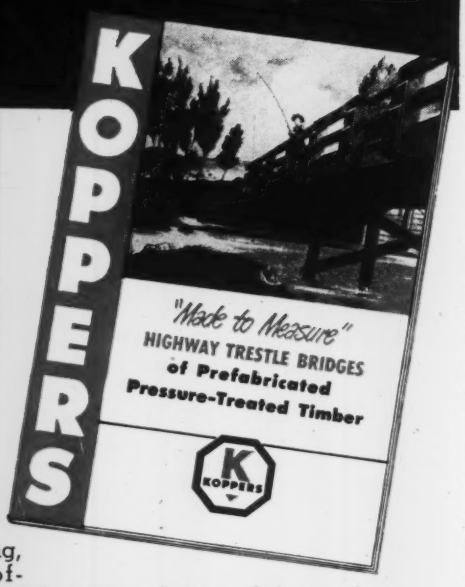
FWD

America's Foremost Heavy-Duty Truck

Save construction Time and Cost with

KOPPERS PRESSURE-TREATED TIMBER





Save Design Time and Cost with this BOOK . . .

Save laborious designing, detailing and bill-of-material preparation in trestle bridge design. Select railing, deck, bent and abutment types desired from this "Made to Measure" bridge book . . . fill out data sheet . . . and mail for quotation. Bridge members available framed and treated; only assembly needed at site. Erect with highway crews plus local labor, no special equipment. Decay-protected—low maintenance cost. If you build trestle bridges, ask for a complimentary copy.

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PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC.

PITTSBURGH 19, PA.

Manufacturers' Publications

259

Alloy Steels—A 24-page booklet listing sizes, shapes, finishes and conditions of medium carbon, high carbon, case hardening, free machining, carbon-manganese machinery steel; heat treated alloys and tool steels available for shipment is prepared by the Ryerson Steel-Service warehouses. The booklet explains the Ryerson certified alloy steel plan and contains tables of AISI and SAE standard steel compositions.—*Joseph T. Ryerson & Son, Inc., P. O. Box 8000-A, Chicago 80, Ill.*

260

Spray Finishing Equipment — This revised catalog not only shows new additions to the company's line of spray painting equipment and accessories but also describes engine cleaners, guns for applying asphalt and other heavy materials, and flow guns for compounds used to seal gaskets, mouldings, cracks, corners and crevices, and air compressor units.—*Binks Mfg. Co., 3,116-40 Carroll Ave., Chicago 12, Ill.*

261

Brass Cleaning and Finishing—A 28-page handbook on cleaning, finishing and coloring copper, brass and bronze. It contains good advice on the maintenance of such metals and alloys used for architectural ornamentation, building fronts and utilitarian purposes in many structures.—*Copper & Brass Research Association, 420 Lexington Ave., New York 17, N. Y.*

262

Stainless Steel Pipe—A bulletin discusses the application of stainless steel pipe, tubing and fittings where corrosion is encountered. Pictures show fittings as they actually appear, with sectional diagrams of flanged and screwed fittings.—*John B. Astell & Co., 90 West Broadway, New York 7, N. Y.*

263

Stopping Wall Leaks—A leaflet tells the advantages of an iron cement to seal leaks in concrete, brick or stone walls or floors, applied on inside and outside surfaces, either wet or dry. The product is also used for surfacing and dust-

"QUICK-WAY"

REG U S PAT OFF

CAN PROVE RESULTS AND INCREASE PROFITS

Everyone wants results — dollars and cents results. Whatever your work, **"QUICK-WAY"** Truck Shovels show you results that increase profits in all their various uses.*

HERE ARE THE RESULTS...

1 You'll spend less time "getting places." **"QUICK-WAYS"** are truck mounted to travel at truck speeds wherever a truck can go. **"QUICK-WAYS"** are designed for proper balance, with low center of gravity, and built with strength where strength is needed.

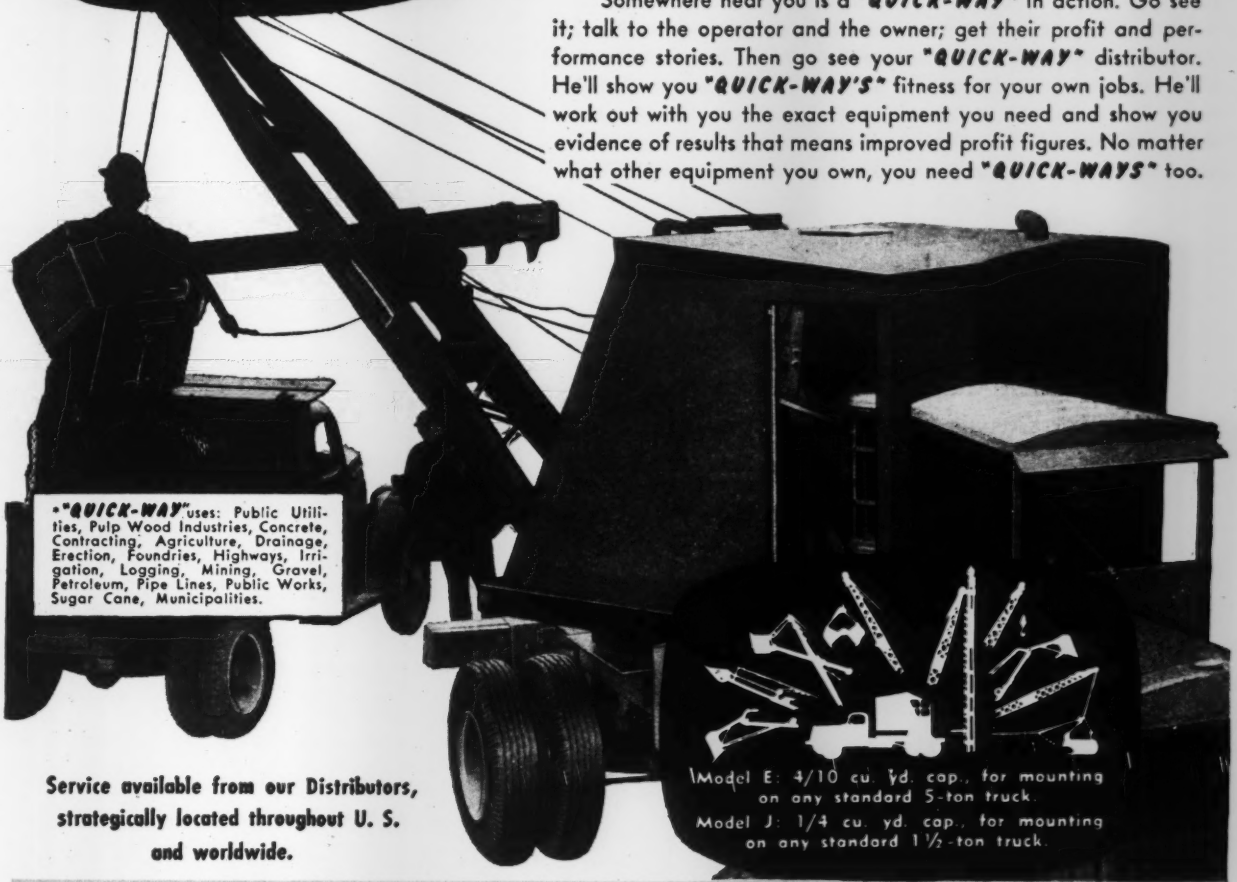
2 You'll spend less time "getting ready." **"QUICK-WAY"** construction is simple and your rig is convertible to any one of seven others in a few minutes, ON THE JOB.

3 You'll do more work in less time. Controls are simple and quick-acting, and **"QUICK-WAY"** hoist and swing action is fact. BALANCED speed gives bigger yardage.

4 You'll spend less time AND MONEY on repairs and maintenance. **"QUICK-WAY"** parts are simple and many vital parts are interchangeable. The entire machine is of quality steel construction—no iron castings.

HERE'S HOW YOU PROVE THEM...

Somewhere near you is a **"QUICK-WAY"** in action. Go see it; talk to the operator and the owner; get their profit and performance stories. Then go see your **"QUICK-WAY"** distributor. He'll show you **"QUICK-WAY'S"** fitness for your own jobs. He'll work out with you the exact equipment you need and show you evidence of results that means improved profit figures. No matter what other equipment you own, you need **"QUICK-WAYS"** too.



*"QUICK-WAY" uses: Public Utilities, Pulp Wood Industries, Concrete, Contracting, Agriculture, Drainage, Erection, Foundries, Highways, Irrigation, Logging, Mining, Gravel, Petroleum, Pipe Lines, Public Works, Sugar Cane, Municipalities.

Model E: 4/10 cu. yd. cap., for mounting on any standard 5-ton truck.
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Service available from our Distributors, strategically located throughout U. S. and worldwide.

For speed, portability, economy of operation, and adaptability to a wider range of jobs, nothing of comparable size equals a "Quick-Way" Truck Shovel.

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DENVER, COLORADO

PIONEER IN POWER SHOVELS FOR TRUCK MOUNTING; STILL THE LEADER AFTER 29 YEARS

CHOOSE from STOCK OR HAVE IT TAILOR MADE

the ROGERS WAY

to meet Your Specific TRAILER REQUIREMENTS

The Rogers policy is to utilize the basic proven designs in building all trailers but to modify them as desired and most practical to meet the specific needs and personal preferences of each purchaser.

In other words, Rogers Trailers are "tailored to each specific need" but built on a basis that utilizes economical, high production methods. Thus, purchasers obtain the utmost in performance and value.

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If considering the purchase of a trailer, write stating your needs and preferences.

You'll certainly want to write for the large illustrated Rogers Catalog which illustrates and describes in detail the complete line of Rogers Trailers.

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DESIGNERS and BUILDERS OF HEAVY DUTY TRAILERS SINCE 1915

EXPERIENCE builds 'em PERFORMANCE sells 'em

135 ORCHARD ST. ALBION, PENNA.

proofing new concrete floors and lining cisterns, pools, tanks, fountains, etc., and repainting joints between brick, concrete or stone blocks, and sealing openings around pipes extending through walls or floors.—*Smooth-On Mfg. Co., 570 Communipaw Ave., Jersey City 4, N. J.*

264

Rock Drill—A pamphlet describes a new self-rotating rock drill which weighs only 9 lb. and is a hand-held pneumatic drill that hits and rotates for speed of penetration. It is convertible to a chipping hammer by the removal of only one part.—*Cleco Division, Reed Roller Bit Co., P. O. Box 2119, Houston, Tex.*

265

Building Maintenance Materials—A pamphlet tells about materials for new floors, foundations, walls, open structural members, mortar joints and for building maintenance.—*Stonehart Co., 401 N. Broad St., Philadelphia 8, Pa.*

266

Bridge Floor—An illustrated folder describes corrugated metal plank 12 in. wide and 3 in. deep which are welded to the stringers, greatly stiffening and strengthening the entire bridge structure. The application of a bituminous surface provides a smooth, non-skid roadway and a continuity between bridge and highway.—*The Toledo Bridge Flooring Co., Byrne Road, Toledo 9, Ohio.*

267

Rubber Products for Industry—A condensed catalog gives special emphasis to transmission and conveyor belting, V-belts, hose, engineered molded products, rubber roll coverings, tank lings, and abrasive wheels.—*Raybestos-Manhattan, Inc., Passaic, N. J.*

268

Powder Bags—A booklet points out how shot placing is speeded up by removing explosives from their boxes away from the operation and carrying them in suitable bags. This method eliminates a certain amount of danger in such operations.—*American Brattice Cloth Corp., Warsaw, Ind.*

269

Air Sanitation—An engineering and application data book outlines the operation of air recovery equipment used in the conversion of stale, vitiated, or contaminated air to its original fresh-

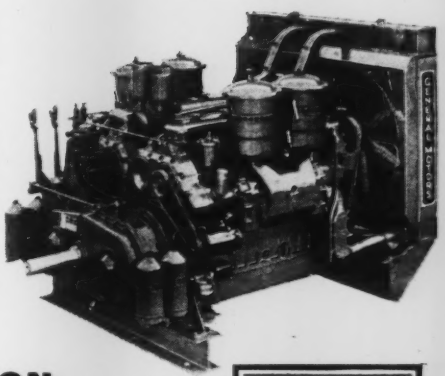
JUST CRAMMED WITH POWER

Marion 111-M 3½ cu. yard shovel strip mining for Yamulla Trucking and Excavating Company of Hazelton, Pennsylvania.

TAKE the case of the Marion 111-M 3½ cu. yard shovel. Here's equipment that calls for plenty of power fitted in a compact cab. This is where a General Motors "Twin" does a masterful job, because it makes available 330 husky, dependable horsepower.

Of course, the Yamulla Trucking and Excavating Company like their new shovel. The smooth electric swing, the snappy mechanical scoop, the economy of fuel and the dependability of its GM Diesels would please any shovel operator.

Discover what GM Diesel power can do for you as a prime mover or in fine contractor's equipment. Get the story from your local GM Diesel dealer or write direct to us.



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SINGLE ENGINES. Up to 200 H.P. DETROIT 28, MICHIGAN MULTIPLE UNITS.. Up to 800 H.P.

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DIESEL BRAWN WITHOUT THE BULK

Use R B & W Bolts and Nuts . . .

Quick-starting, quick-tightening because they are accurately, uniformly sized and threaded — and carefully inspected.

Vibration-resisting, shock-resisting because the manufacturing method insures extra strength, and all processing is controlled from raw rod to finished product.

EMPIRE BOLTS RIVETS NUTS

AND ALLIED FASTENING PRODUCTS . . . SINCE 1845

RB&W *Making strong the things that make America strong*

Russell, Burdsall & Ward Bolt and Nut Company. *Factories at* Port Chester, N. Y., Rock Falls, Ill., Coraopolis, Pa., Los Angeles, Calif.; *additional sales offices at* Philadelphia, Chicago, Detroit, Chattanooga, Oakland, Portland, Seattle

ness, either to conserve it for re-use or to correct exhaust and intake odor nuisances. The equipment consists of hollow-walled cylindrical canisters containing specially processed activated carbon and a manifold or supporting plate in which the canisters are secured.—*W. B. Connor Engineering Corp., 114 East 32d Street, New York 16, N. Y.*

270

Macadam Pavements—An informational bulletin has been issued by a technical organization for research and engineering study to improve and develop macadam pavements. It describes approved construction methods, and gives typical sections of pavements built and under construction.—*Macadam Pavements, Inc., 1018-19 Huntington Bank Bldg., Columbus 15, Ohio.*

271

Insulating Concrete—These advantages of this product are given in a circular: permanence, incombustibility, economy, light weight and proof aginst rot. Photographs show typical short span structural roof decks, and specifications are given.—*Universal Zonolite Insulation Co., 135 So. LaSalle Street, Chicago 3, Ill.*

272

Safety Belts and Nets—Folder tells of safety belts made of linen webbing to which is stitched a 3x44-in.-long body pad of 4-ply cotton webbing, reinforced with rawhide. A special belt for bridge and structural steel work is made of harness leather 2 in. wide. Nets are made by hand of best grade selected rope to any size required.—*Atlas Safety Equipment Co., Inc., 26 Warren St., New York 7, N. Y.*

273

Sign-Maker—Booklet is a complete catalog of lettering guides which save time and money in lettering and sign-making. The guides and pens come in a bakelite cabinet.—*The Wood-Regan Instrument Co. Inc., Nutley, N. J.*

274

Foundation Columns—8-page bulletin tells of drilled-in caissons, a system of foundation columns anchored in rock sockets. Advantages include: Heaviest column loads are carried on single caisson; any type of soil can be penetrated; rock at any depth can be reached; examination of rock is possible; mechanical digging methods without compressed air eliminate hazards to workmen; confined space is usually no obstacle; economy of time and labor. —*Drilled-in Caisson Corp., 2 Park Ave., New York 16, N. Y.*

Men and Jobs

Lynton R. Newhall, civil engineer, has been appointed resident engineer for the Corps of Engineers on construction of the $4,000,000 veterans' hospital at Spokane, Wash. He transferred to the Seattle District recently from the air Materiel Command Headquarters, Wright Field, Dayton, Ohio. A graduate of the Pennsylvania Military College in 1903, he has served with four other government departments.

Norman Hebden, associate director of the American Public Works Association, has resigned to accept an associate professorship at Yale University where he will conduct a research project for the university's Bureau of Highway Traffic.

W. W. Sullivan and **V. C. Wordrup** have formed the Sullivan-Wordrup Construction Co. at Fort Lauderdale, Fla. During the war Mr. Sullivan was an officer in the Corps of Engineers in charge of general construction work in Florida and South America, while Mr. Wordrup was in similar work in the same areas as a civilian employee of the War Department.

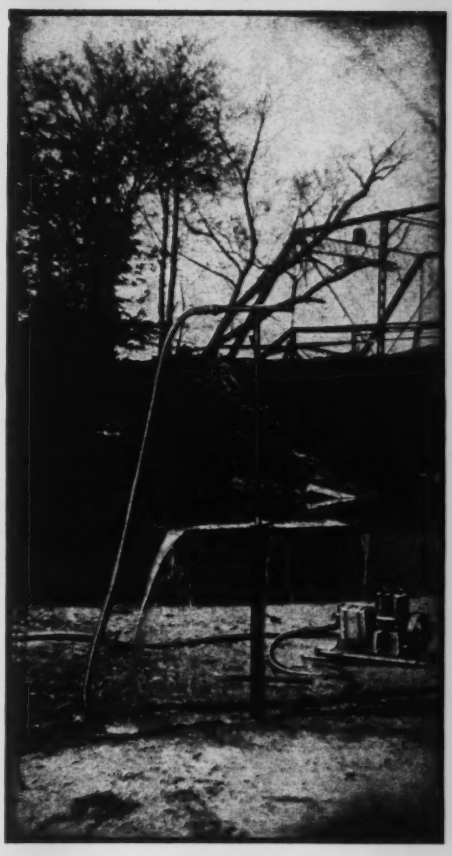
F. Talmage Green, assistant city manager of Wilson, N. C., since last fall, was appointed city manager after **W. M. Wiggins,** former manager, resigned. Green was formerly field engineer for the Portland Cement Association and also engineer with the North Carolina State Highway & Public Works Commission for a number of years.

Herbert J. Baker, supervising engineer with Defense Plant Corp. on construction of the Sperry Gyroscope Corp. plant, Lake Success, N. Y., Consolidated Vultee Aircraft Corp. plant, New Orleans, La., and other construction work, is now with the Corps of Engineers, Grecian District, as engineer on bridge reconstruction, and is stationed in Athens.

Roy Rubright has been appointed city engineer of Hammond, Ind. Mr. Rubright, a graduate of Purdue University in civil engineering, for 18 years was a design engineer with Sinclair Refining Co.

FOR FAST AND LOW COST
ACCURATE KNOWLEDGE OF BEDROCK CONDITIONS

Empire
HYDRAULIC TESTING DRILL



When you drill to bedrock you want to know your subsurface conditions — but at LOW COST. Here is the rig that you can transport and set up easily and economically in rough country, with a couple of men if necessary. Designed especially for this class of work. Extensively used by U. S. and State Governments and many others. Extremely strong and simple.

Easy to transport, set up, take down
JUST THE DRILL FOR ROUGH COUNTRY

Outfit weighs only a total of 800 lbs. for 50 ft. drilling depths. Gives accurate samples of materials drilled. Every part can be handled by one or two men.

Send for descriptive circular giving complete specifications. It will help if you advise us regarding drilling depths and general nature of work.

NEW YORK ENGINEERING COMPANY
75 WEST ST., NEW YORK, N. Y.
Works: YONKERS, N. Y.

Your Work Will Go Easier and Faster
With
SYNTRON
CONSTRUCTION and MAINTENANCE TOOLS

Busting concrete, digging clay, shale and frozen ground; cutting asphalt and tamping backfill—with Gasoline Hammer Paving Breakers.

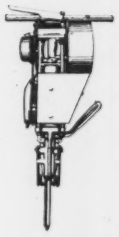
Drilling, cutting, chipping concrete and masonry; vibrating concrete forms and molds; scaling concrete, rust and old paint from equipment—with Electric Hammers.

Drilling, sanding, buffing and polishing wood and metal with Electric Drills and Sanders. Grinding welds and wire brush work with Electric Grinders.

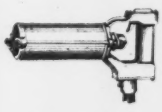
Vibrating thin wall forms; burial vault forms, pipe forms and other precast concrete products with electromagnetic Form Vibrators. Vibrating bridge decks, floor slabs, piers, etc. with flexible shaft Mass Vibrators.

Write for literature on this TIME AND COST SAVING equipment.

SYNTRON CO.
328 Lexington **Homer City, Pa.**



"Gasoline Hammer"
PAVING BREAKERS
100% Self Contained



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ELECTRIC HAMMERS

"Portable"
ELECTRIC DRILLS

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38 YEARS INSTALLING PILES
OF EVERY TYPE
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MacARTHUR CONCRETE PILE CORPORATION
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BOSTON • CINCINNATI • NEW ORLEANS

Carey C. Burnett of Thomasville, Ga., has been appointed city engineer of Valdosta.

Augustine J. Muller, senior engineer of the Baltimore, Md., County planning commission has resigned to go into the real estate business.

Forrest Johnson has been appointed director of the maintenance division of the Kentucky highway department.

Paul L. Holland, director of public works at Baltimore, Md., has been selected as Maryland candidate for the board of direction of the ASCE.

Robert B. Rhode has resigned as division engineer of the Northern Pacific Railway Co., Missoula, Mont., to become bridge engineer with the Duluth, Missabe, and Iron Range Railway Co. at Duluth, Minn. **Reese W. Humphreys** will succeed Mr. Rhode. He formerly was assistant bridge and building supervisor at Missoula for the N.P.

James P. King, since 1940 a staff member of the U. S. Army Engineer Corps at Boston, Mass., has been appointed manager of the Peabody, Mass., municipal electric light department. Mr. King is a graduate of the University of Maine, and in his earlier career was engaged in laboratory work at the Massachusetts Institute of Technology. He was active in the construction of the Castle Island Port of Embarkation, Boston, during the war.

Resignation of two engineers has been announced by the Pennsylvania State Highways Department. They are **Merrill D. Hammon,** of Huntingdon, project engineer in District 9, Hollidaysburg, and **Gemmill C. Davis,** of Glenshaw, district plans engineer in the District 11 office at Pittsburgh.

M. R. Smith, Jr. has withdrawn from the consulting engineer partnership of Parkhill, Smith & Cooper of Lubbock, Tex., to become manager of that city. The firm will continue as Parkhill & Cooper.

Maurice H. Brown, Los Angeles, Calif., construction engineer for Morrison-Knudsen, has gone to Afghanistan to become assistant project manager of that company's operations there. He will be at the Kabul headquarters, where **James F. Horan** is project manager. For the last three years, Brown directed many railroad construction and rehabilitation projects for Morrison-Knudsen de Mexico, S. A., on the Mexican National Railway in the Tehuantepec Peninsula.

These DU PONT Products make an efficient team on trench blasting job

1. Drilling holes 12 feet deep in soft-shooting rock at Aspen Creek Siphon job site of Colorado-Big Thompson Project near Estes Park, north of Denver.

2. Loading Du Pont "Red Cross" Blasting #4 (Free Running) Dynamite from 12½-pound bags. Contractor Horner & Switzer, Denver, used Du Pont Explosives.

3. Priming with Du Pont "Gelex" No. 2, 45%, in perforated cartridges. Job required a total of 23,400 Du Pont Electric Blasting Caps.

4. Firing a typical blast in constructing the siphon trench. Shots were successfully pulled with a Du Pont No. 100 Blasting Machine.

5. Excellent breakage facilitated removal of stone. "Red Cross" Blasting and "Gelex" made a team that enabled contractor to keep ahead of schedule.

6. Completed section of siphon showing huge reinforced concrete pipe in clean-cut trench efficiently and economically blasted with Du Pont Explosives.

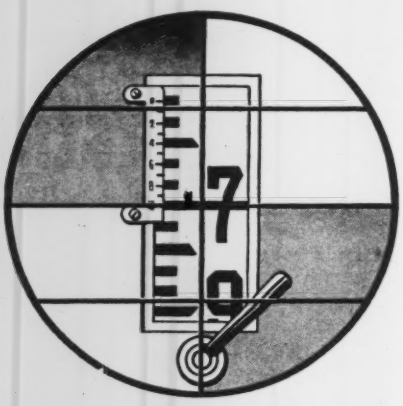
DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

Ask any Du Pont Explosives representative for complete information about these and other dependable products for efficient blasting. E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

DU PONT EXPLOSIVES

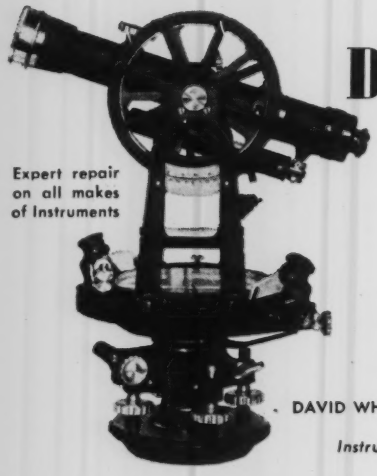
Blasting Supplies and Accessories



When you're on target with a White ...you're absolutely right!

- You can be absolutely confident of precision results with White instruments. That's because every step in their manufacture is made with that thought in mind. For example, the metals used in making various parts are a special bronze, brass and nickel silver. Whenever advisable, individual parts are carefully heat-treated to remove all internal stress and strain.
- But that's only part of the story — all graduations on White instruments are guaranteed for accuracy — they're made by a special dividing engine in a totally enclosed heat-controlled, air-conditioned room. Graduating surfaces are grained Sterling Silver to reduce reflection to preserve accuracy.
- Finally — White instrument optics are coated — to transmit the brightest and sharpest possible image through the sighting telescope. Brightness is increased as much as 40 per cent because of increased light transmission — contrast is improved by reducing the haze caused by internal reflections.

Write today for detailed literature and price data.
For the finest in instruments — Specify White's.



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Illustrated, famous Type II Transit No. 7016. Telescope 11½" long — internal focusing — 24 power. Horizontal limb graduated to 15 minutes, Verniers to 20 seconds, 6½" diam.

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Manufacturers of
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Elections and Activities

Ira L. Elmer, Commissioner of Public Works, Rome, N. Y., has been appointed New York State chairman of the American Public Works Association.

At the annual meeting of the Alberta Land Surveyors C. H. Snell, Red Deer, was elected to succeed G. Z. Pinder, Calgary, as president and S. K. Pearce and R. McCutcheon, of Calgary, were elected councilors.

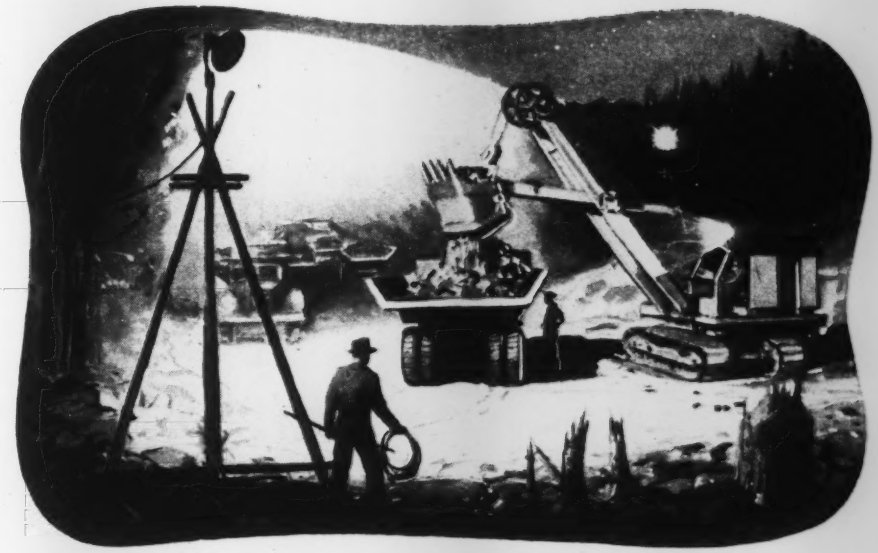
Officers elected for 1948 by the Associated General Contractors of Missouri are: president, Alexander Maitland, president, Kansas City Bridge Co., Kansas City, Mo.; vice-president, J. R. Bushman, president, Bushman Construction Co, St. Joseph, Mo.; treasurer, J. M. Joyce, (vice-president, Cameron, Joyce & Co., Keokuk, Iowa; and secretary and manager, E. C. L. Wagner, Jefferson City, Mo. The association will sponsor an Engineer Aviation Battalion.

L. J. H. Smith of Miller-Haynes-Smith, Inc., Henderson, has been elected president of the Nevada Society of Professional Engineers. George Maxey, Geodetic Survey, Ely, was chosen 1st vice-president; J. H. Buehler, Bristol Silver Mines, Pioche, 2nd vice-president; J. A. Tiberti, Walle, Camplan & Tiberti, Las Vegas, 3rd vice-president; A. T. Newell, Stauffer Chemical Co. Henderson, secretary; R. T. Campbell, also of Stauffer's, treasurer, and A. J. Shaver, Las Vegas, national director.

Ontario General Contractors Association elected C. E. Potter, Toronto, president; H. J. Bell, Ketchener, vice-president; Robert Teagle, Toronto, treasurer and Norman Fraser, Toronto, secretary-manager.

W. A. Klinger, Sioux City, Ia., past president of the Associated General Contractors of America and of the Associated General Contractors of Iowa, has been appointed a member of the national building trades industry committee created to serve as advisors to the congressional joint committee on housing.

A. C. Wittera, Kearney, has been elected president of the Nebraska Good Roads Association; Louis Hines, Omaha, vice-president; O. K. Brand-



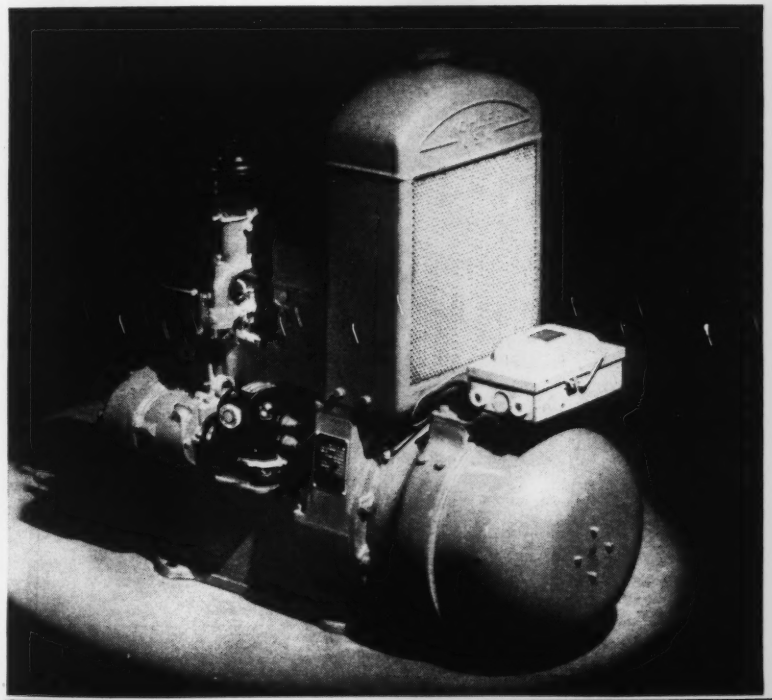
KOHLER ELECTRIC PLANTS

provide reliable light and power for 'round-the-clock schedules on "Thruway"

By night as well as by day, work goes on swiftly and smoothly on Thruway, the 486 mile highway across the state of New York, scheduled for completion in 1951. Kohler Electric Plants provide the night shift with all the electricity they need for general lighting, floodlights, motors, pumps and numerous power tools.

Kohler Electric Plants are known throughout the world as a reliable, convenient, economical source of auxiliary light and power on construction jobs of all kinds. They are also widely used for stand-by service, to protect industrial or public institutions and private homes against hazard or loss that might result from interruption of public utilities electricity.

Kohler Plants are backed by the 75-year-old tradition of Kohler quality. They can easily be mounted on cranes, power shovels, draglines and other machinery. Sizes are from 800 watts to 10 KW, AC or DC, with or without metal housing and skid base for portable service. Write for illustrated Folder B-7. Kohler Co., Kohler, Wisconsin. Established 1873.



Kohler Electric Plant Model E, 1500 watts, 115 volt DC.

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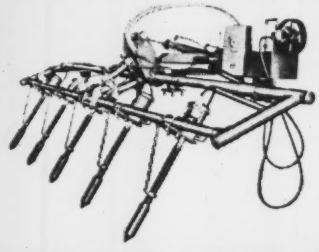

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One man and a Sauerman Power Scraper will dig, haul and place a big yardage of any material a plough can turn. These fast, powerful machines excavate equally well under water, on swampy ground, on hillsides or in pits. Costs are slashed because of low upkeep and one-man operation. Sauerman equipment makes greater profits for contractors the world over.

Picture shows how a small Sauerman Scraper was set-up to clean out a large settling pond, choked by many years' accumulation of silt and waste. Scraper machine straddled the pond with a light head-tower on one bank and tail A-frame on the other bank, moving along at rate of a few feet a day until it had scraped out the entire basin and spread the spoil on the bank. Now an occasional brief run of the scraper keeps the pond clean.

Efficiency—Speed—Economy

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stetter, Wayne, 2d vice-president; Allan Davison, Beatrice, treasurer; and Harry Byrne, Omaha, secretary.

The southern Nevada chapter of the Nevada Society of Professional Engineers has re-elected C. G. Petrie, Las Vegas city planning engineer, president. Harlan Brown, Las Vegas city engineer, was named vice-president; Harry Hall, Boulder City city engineer, secretary-treasurer, and Frank Rathbun, Sr., of Rathbun & Sons, and George Van Tobel of C. D. Baker Co., Las Vegas, trustees.

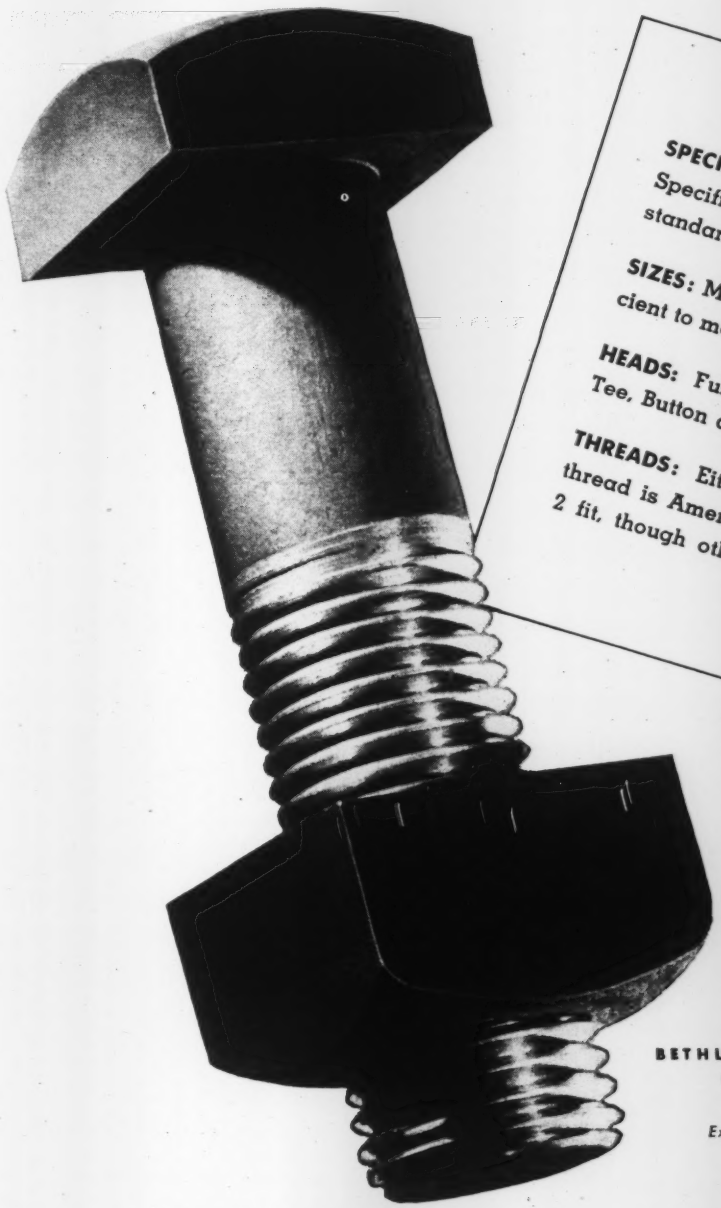
Miles N. Clair has been elected president of the Northeastern Section of the American Society of Civil Engineers. Other officers elected were:—Arthur L. Shaw, vice-president; Earle P. Littleton, secretary-treasurer; Oscar Bray and John L. Wilbur, executive committee.

Three railroad men have been elected officers of the Cleveland, Ohio, section of the American Society of Civil Engineers. Wendell R. Swatosh, assistant engineer, Erie Railroad, is the new president, succeeding Arthur H. Stark, engineer, Ohio Bell Telephone Co. Howard F. Schryver, special assistant to the chief engineer, New York Central System, is vice-president, and Alfred D. Yanda, principal engineer, Cleveland Transit System, was re-elected secretary-treasurer. Certificates of life membership were awarded to James G. Esch, president, Esch Construction Co., and Rowland G. Rice, senior engineer (retired), Ordnance Dept., U. S. Army, both of Cleveland.

More than 1,000 members of the Minnesota Association of Professional Engineers and the Minnesota Federation of Engineering Societies held a joint annual meeting at St. Paul recently, to hear discussions of professional problems and elect officers for the coming year. New officers of the Professional Engineer group are: T. S. Thompson, Minneapolis, president; M. C. Peterson, Bemidji, vice-president; C. C. Colwell, St. Paul, secretary and N. T. Ryken, St. Paul, treasurer. Leaders of the federation will be: Garold Felland, Minneapolis, President; Hugo Schlenk, Jr., Cloquet, and J. L. Wilson, St. Paul, vice-presidents, and N. J. Ryken, secretary-treasurer.

At the recent annual meeting of the Calgary, Atla., Branch of The Engineering Institute of Canada, Capt. R. T. Hillies was elected chairman as successor to M. W. Jennings, and T. M. Parry secretary-treasurer with D. C. Jones, G. Hutton, J. J. Hanna and J. H. Wilson as executives.

Machine Bolts



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SIZES: Made in a wide range of sizes, sufficient to meet practically every need.

HEADS: Furnished with Square, Hexagon, Tee, Button and Countersunk Heads.

THREADS: Either cut or rolled. Standard thread is American Standard Coarse, Class 2 fit, though other types can be furnished.

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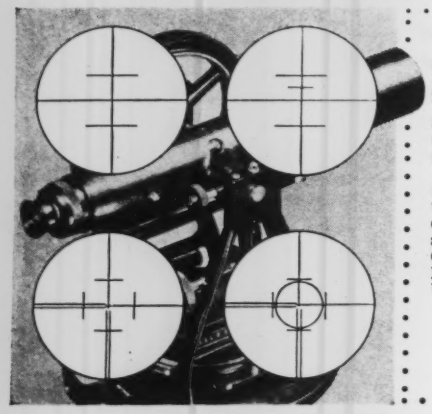

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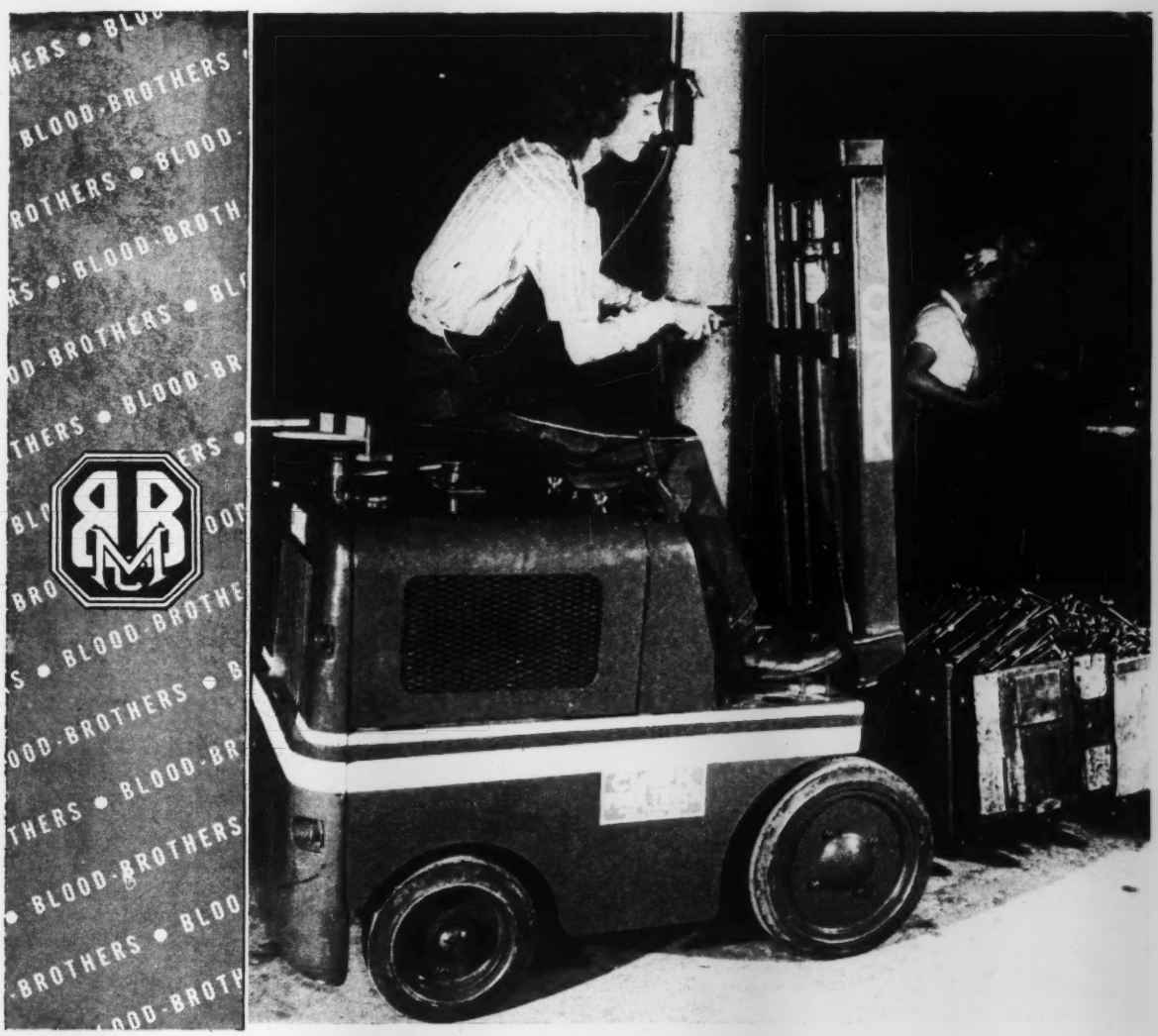
Manufacturers' Activities

Current developments among manufacturers relating to expansion of services, shifts in personnel, and other changes, include the following:

Sales Staff News—Harold N. Propp, sales engineer, has been transferred to the San Francisco district office of the NORDBERG MFG. CO., Milwaukee, Wis. . . . Wallace Young is a special representative for the sale of KENNAMETAL construction tools and other products in the West Indies and South and Central America south of Mexico . . . INTERNATIONAL HARVESTER motor truck division has announced these changes in branch personnel: H. A. Herman goes from Syracuse, N. Y., to be assistant manager at West Haven, Conn.; P. E. Thomas from Parkersburg, W. Va., to Syracuse, N. Y., as assistant manager; W. H. McBryde from Charleston, S. C., to Parkersburg as assistant manager; M. F. Williams from Wichita, Kan., to San Antonio, Tex., as assistant manager; and F. C. Mayer, from Birmingham, Ala., to Charlotte, N. C., as assistant manager. . . . R. G. Huntress has been made manager of wire rope sales for THE CALIFORNIA WIRE CLOTH CORP., subsidiary of THE COLORADO FUEL AND IRON CORP. . . . M. A. Boyle is sales manager of the solder division of ALPHA METALS, INC., Brooklyn, N. Y. C. . . . Frank M. Sweeney has been appointed sales representative of IRON & STEEL PRODUCTS, INC., of Chicago, Ill., in the Baltimore, Md., district at 4136 Roland Ave., Baltimore 11, Md. . . . Carl P. Simmons has been appointed service engineer of the Philadelphia territory of the NELSON SALES CORP., Lorain, Ohio. His office is Lansdowne Center Bldg., Lansdowne, Pa. . . . Raymond K. Collick has been named parts merchandizing manager of the DETROIT DIESEL ENGINE division, GENERAL MOTORS CORP. . . . Robt. L. Lowder has been named district sales manager in charge of the new Jacksonville, Fla., office of the LINK-BELT CO. at 137 E. Forsyth St. . . . John R. Queen has been named dealer supervisor at New York for ALLIS-CHALMERS for the district offices in New York, Buffalo, Rochester and Syracuse, N. Y. and Newark, N. J. . . . At Madison, Wis., NAGLE-HART TRACTOR & EQUIPMENT CO. and at San Jose, Calif., DITZ BROS., will be CATERPILLAR products distributors.

Personalities—R. R. Tatnall has been appointed field service metallurgist in



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DIVISION OF STANDARD STEEL SPRING CO.

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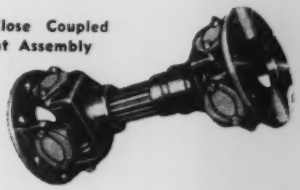

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charge of customer relations for THE COLORADO FUEL AND IRON CORP., WICKWIRE SPENCER STEEL division . . . N. S. Sanborn, Seattle, Wash., has been made West Coast district manager for YORK-HEAT automatic residential heating equipment for YORK-SHIPLEY, INC., York, Pa. . . . Frank R. Cooper has been advanced from vice-president to president of the HOWARD-COOPER CORP., heavy equipment distributors, Portland, Ore. . . . John M Garoutte is works manager of the PERMANENTE CEMENT CO., at Permanente, Calif. Howard Church will succeed Garoutte as works manager of the company's alumina plant at Baton Rouge, La. . . . John M. Palmer, sales manager of the LEE CLAY PRODUCTS CO., Clearfield, Ky., has been elected president of the NATIONAL CLAY PIPE MFGS. ASSN. . . . Ralph V. Baker, assistant secretary, has been named a vice-president of OMEGA MACHINE CO., a division of BUILDERS IRON FOUNDRY, Providence, R. I. . . . Robt. A. Lamson has been made assistant division manager of the Findlay division of GAR WOOD INDUSTRIES, INC. at Findlay, Ohio. . . . Carl D. Franks has been elected vice-president for promotion of the PORTLAND CEMENT ASSN. . . . L. M. Keating, assistant to the president in charge of distribution of the A. O. SMITH CORP., has been appointed executive administrator of the company's southwest district office in Houston, Tex. . . . After 41 years of service with the AMERICAN STEEL AND WIRE CO. Wm. H. Dodge has retired as Chicago district traffic manager. . . . A. O. Anderson has been appointed senior field engineer of western division for ROCK ENGINEERING CO., Pittsburgh, Pa.

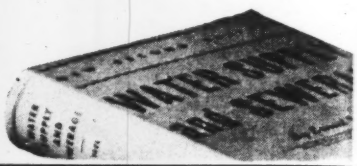
Miscellany—The business and assets of WESTERN CRANE SERVICE CORP. have been purchased by Fritz Awalt, who will operate the business as WESTERN CRANE SERVICE at its Berkeley, Calif., yard and office . . . S. K. F. INDUSTRIES, INC., now has 15 district and 4 branch offices in the U. S., the latest at Charlotte, N. C. . . . BERRY ASPHALT CO. has moved its main office from Chicago, Ill., to Magnolia, Ark. . . . NORTHWEST PLYWOOD manufacturers and government officials met in Washington, D. C., March 30 to discuss channeling plywood to pressing housing needs . . . The CROMAR CO. Williamsport, Pa., has recently resumed the manufacture of Cromar factory-finished oak flooring.

Deceased—Albert C. Burch, manager of market research for the THEW SHOVEL CO., since 1938, and formerly president of THE CLYDESDALE MOTOR TRUCK CO., died March 12 in Sandusky, Ohio. Mr. Burch had travelled extensively and was instrumental in the development of the present type of rubber-tire mounting on shovels and cranes.

How to design and operate

water supply and sewerage systems

City engineers, sanitary engineers, water and sewage works operators, and others will find this book a thorough, up-to-date guide to the essentials of design, the latest purification methods, and sewage disposal systems. This book provides you with tested solutions to your water supply and sewerage problems.



Section Edition

WATER SUPPLY and SEWERAGE

By Ernest W. Steel

Consulting Engineer to Instituto Nacional de Obras Sanitarias, Venezuela; Formerly Professor of Municipal and Sanitary Engineering, Agricultural and Mechanical College of Texas.

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This new second edition covers in detail everything the engineer needs to handle the varied problems of supplying municipal water and removing sewage. It discusses in a thorough manner the development of public water supplies, design and construction of water distribution systems, pumping of water, methods of water treatment, stream pollution and self-purification of streams. The most recent innovations in sewerage systems are discussed in full, giving you information on design and construction of storm and sanitary sewers, methods of disposal, maintenance, filtration, disinfection, etc. Here is a book that will help you all along the line — in planning and construction of new systems and improving and maintaining your present system.

Pertinent, usable data on:

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— Pumping and conveying water
— Impurities and diseases carried by water
— Treatment of water; filters, chemicals, etc.
— Gauging storm sewerage needs
— Pumps, siphons, grease traps and other devices
— Sewerage design and construction
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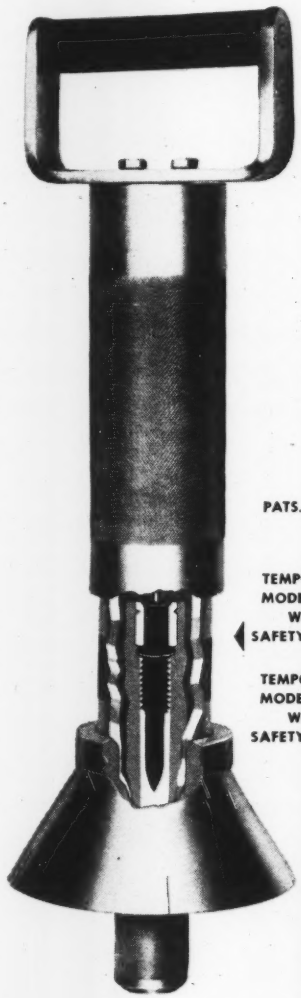

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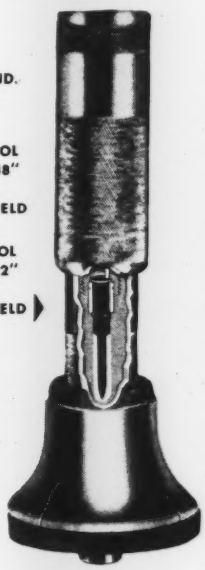

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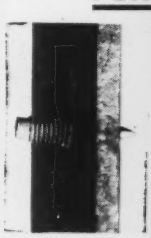

A ½" USS threaded stud driven through a ½" hot rolled steel plate.

A TEMPOTOOL threaded stud withdrawn from a concrete wall. Note how concrete clings to the stud.

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The cut-away illustration shows the powder charge and stud seated in the breech ready for operation.

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FASTENS STEEL TO CONCRETE

like that!

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5. EXCLUSIVE MACOMBER DESIGN! Only the Macomber Longspan has the U shaped diagonal web with its excellent welding face for chord angles.

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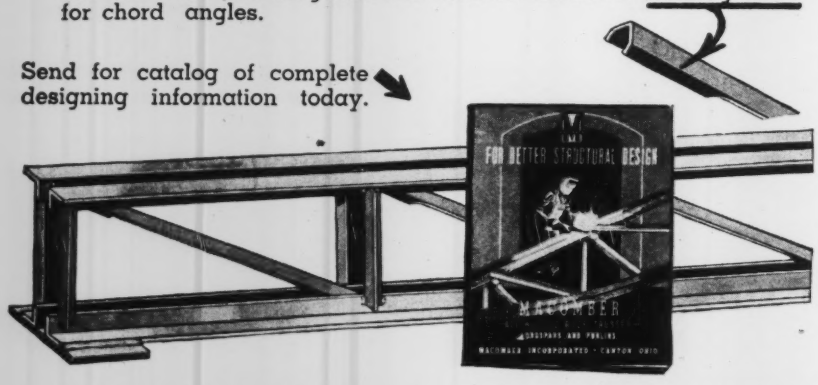

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Recovery of road funds asked in several states

Recovery of highway funds diverted to non-highway uses is being called for in at least four states.

In South Dakota, a legislative interim highway committee has been urged to introduce legislation for gradual return to highway purposes of more than $9,000,000 diverted to rural credit interest and sinking funds between 1933 and 1942. In Illinois, organized rural letter carriers formally asked for return of diverted funds.

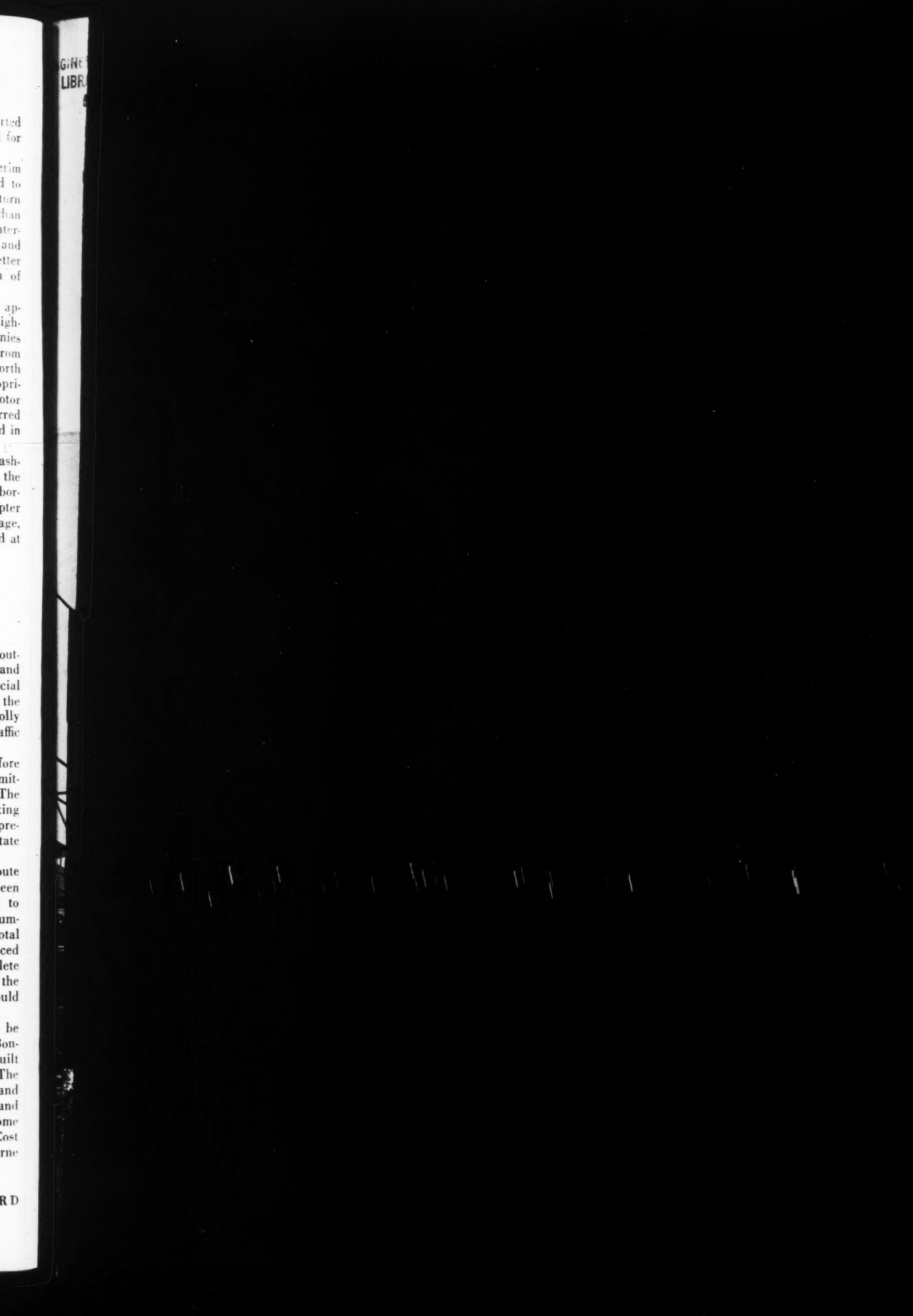
The 1947 Delaware legislature appropriated $2,000,000 to the state highway department in repayment of monies borrowed in 1935, 1937 and 1939 from the State Highway Fund. The North Dakota legislature in 1947 appropriated $2,941,718 to reimburse the motor registration fund for monies transferred to the real estate bond payment fund in 1933.

A bill introduced in the 1947 Washington legislature to restore to the motor vehicle fund $10,277,349 borrowed under the provisions of Chapter 65, Laws of 1933, failed of passage, but undoubtedly will be re-presented at the next legislature.

Propose shorter route Portland to The Dalles

The Columbia River highway has outlived its purpose as a scenic road and it has now become a great commercial artery feeding into Portland from the east. As such an artery it is wholly inadequate to carry the heavy traffic that flows over it daily.

These contentions were placed before the Oregon legislative interim committee on highways at a hearing at The Dalles, Ore. The committee is making a statewide study of highway needs preparatory to reporting to the next state legislature.

A proposed new water-grade route would reduce the distance between Portland and The Dalles from 82 to 71.87 mi. and would reduce the number of curves from 705 to 136. Total degrees of curvature would be reduced from 24,135 to 2966, or 8.3 complete circles as compared with 67 on the present road. Total rise and fall would be reduced from 8731 ft. to 2478 ft.

Total cost of the project would be $20,150,000. The section between Bonneville and Cascade Locks was rebuilt as part of the Bonneville project. The section between Cascade Locks and Viento is within a national forest and funds for its reconstruction would come from federal forest appropriations. Cost of the rest of the work would be borne by the state.